The
Geographical Journal.

No. 3. SEPTEMBER, 1903. Vol. XXII.

BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.*

Under the Direction of Sir JOHN MURRAY, K.C.B., and LAURENCE PULLAR, F.R.S.E.

Introductory.

During the years 1883 and 1884, the Royal Societies of London and Edinburgh urged Her Majesty's Government to undertake a bathymetrical survey of the principal Scottish fresh-water lochs. The Government, however, declined to undertake such a survey, because this work did not fall within the scope of the Ordnance Survey nor of the Hydrographic Department of the Admiralty.† In the years 1897 and 1898, Sir John Murray and the late Mr. Fred. Pullar, F.R.S.E., commenced to sound systematically some of the more important of the Scottish lochs, on the lines indicated in the letter addressed to Her Majesty's Government by the Royal Society of London in the year 1884. The results of these observations were published in the years 1900 and 1901, in two papers dealing with the lochs of the Forth basin and two of the lochs of the Tay basin.‡ Arrangements had been completed for carrying on this survey during the summer of 1901, but the whole work was brought to a standstill by an unfortunate ice-accident in Airthrey loch, near Bridge of Allan, on February 15, 1901, in which Mr. Fred. Pullar lost his life while gallantly endeavouring to save others.§

* Maps, p. 356.

† This correspondence is published in the *Geographical Journal* (*see* vol. xv. p. 309, 1900) and in the *Scottish Geographical Magazine* (*see* vol. xvi. p. 193, 1900).

‡ "A Bathymetrical Survey of the Fresh-water Lochs of Scotland." Part i. *Geogr. Jour.*, vol. xv. p. 309, *Scott. Geogr. Mag.*, vol. xvi. p. 193, 1900; Part ii. *Geogr. Jour.*, vol. xvii. p. 273, *Scott. Geogr. Mag.*, vol. xvii. p. 113, 1901; Part iii. No. 1, *Geogr. Jour.*, vol. xvii. p. 289, *Scott. Geogr. Mag.*, vol. xvii. p. 169, 1901.

§ See *Geographical Journal*, vol. xvii. p. 313; *Scottish Geographical Magazine*, vol. xvii. p. 148, 1901.

FIG. 1.—THE LATE FRED. P. PULLAR, F.R.S.E.

(From a photograph by Sir John Murray, taken on the shores of Loch Leven, September 1, 1900. Lunch-time on his last sounding expedition.)

FIG. 2.—SIR JOHN MURRAY, K.C.B.

(From a photograph taken by the late F. P. Pullar, F.R.G.S., during lunch-time on their last sounding expedition together. Loch Leven, September 1, 1900.)

The tragic death of this rising young geographer produced a profound sensation in the community in which he lived and amongst his numerous scientific and other friends. Various local memorials have been established to his memory.*

Some time after the death of his son, Mr. Laurence Pullar approached Sir John Murray with regard to the feasibility of continuing and completing the work so unfortunately interrupted; he expressed his willingness to fill his son's place as far as possible, and, at all events, to set aside a sum of money sufficient to pay for such assistance as Sir John might desire in carrying on the work and publishing the results. He was even in favour of the scope of the work being extended so as to include all the inland waters of the United Kingdom, and to embrace physical and biological observations in addition to the routine sounding work. Mr. Pullar wished to be assured on two points: *first*, that there was no likelihood of any Government Department carrying out such a survey; and, *second*, that the work was considered, by competent authorities, important and desirable from a scientific point of view. In these circumstances the question of the renewal of the survey was submitted to the Councils of the Royal Societies of London and Edinburgh. Both Councils passed resolutions stating that they learnt with great satisfaction that arrangements were under consideration for the completion of the survey commenced by Sir John Murray and the late Mr. F. P. Pullar, and confirmed their opinion as to its great scientific importance. A similar resolution was also passed at the British Association meeting at Glasgow in 1901.†

---

* A volume of press and other public and private references to his death was printed for private circulation, and memorial prizes were given at Stirling High School and in connection with the Marine Biological Association of the West of Scotland, etc.

† Copy of Resolution passed by the Council of the Royal Society of London, June, 1901.

Mr. Teall informed the Council that a number of Fellows and others interested in the subject had heard a statement by Sir John Murray with reference to a bathymetrical, physical, and biological survey of the fresh-water lakes of Great Britain and Ireland. It appeared that the Council had urged the importance of a bathymetrical survey of the principal fresh-water lakes of the country in a letter to Her Majesty's Government, dated May 2, 1884, and that a survey on the lines therein indicated had been commenced, so far as Scotland was concerned, by Sir John Murray and Mr. F. P. Pullar, but had been unfortunately interrupted by the accidental death of the latter gentleman. Mr. Laurence Pullar (the father of Mr. F. P. Pullar) had now intimated to Sir John Murray that he was willing, on certain conditions, to set aside a sum of money to enable this survey to be completed, and to be extended to all inland bodies of water. The conditions were as follows:—

(1) That there was little likelihood of this survey being undertaken by any of the Government Departments.

(2) That Sir John Murray would himself undertake the general superintendence of the survey and the publication of the results.

(3) That, in the opinion of the Council of the Royal Society, it was important from

Although His Majesty's Government could not see its way to undertake a bathymetrical survey of the Scottish fresh-water lochs, still several Public Departments have taken a deep interest in the work and

---

a scientific point of view, in addition to the bathymetrical survey recommended in their letter of May 2, 1884, to undertake at the same time an investigation into the physical and biological conditions of the fresh-water lakes.

As soon as the Council had declared their opinion, Sir John Murray was prepared to draw up an approximate estimate of the cost of the work for Mr. Pullar's consideration.

It was resolved—That the Council confirm the opinion expressed in their letter to Her Majesty's Treasury of May 2, 1884, as to the great scientific importance of a bathymetrical survey of the fresh-water lakes of the United Kingdom, and that they have learnt with great satisfaction that arrangements are under consideration for the completion of the survey commenced by Sir John Murray and Mr. Pullar, and are of opinion that the scientific value of the survey will be greatly increased if it embraces a study of the biological and physical conditions of the lakes.

EXTRACT FROM A MINUTE OF MEETING OF THE COUNCIL OF THE ROYAL SOCIETY OF EDINBURGH, HELD ON MAY 24, 1901.

The Council heard a statement from Sir John Murray with reference to a bathymetrical survey of the fresh-water lochs of Scotland to the effect that Mr. Laurence Pullar was willing, on certain conditions, to set aside a sum of money to enable the survey to be completed which had been commenced by Sir John and Mr. Pullar's son, Mr. F. P. Pullar, but which had been interrupted by the unfortunate death of the latter gentleman by accident.

Mr. Pullar was prepared to do this provided Sir John would himself undertake the general superintendence of the survey and the publication of the results; provided, also, that the Council still regarded such a survey as important from a scientific point of view, and that it had been, and was likely in future to be, satisfactorily carried out on the lines suggested by the Council in the year 1884.

Sir John had been requested to prepare an approximate estimate of the cost of completing the survey for Mr. Pullar's consideration, and he now asked the Council for suggestions as to any scientific observations that might with advantage be undertaken in connection with the survey. There was much discussion with regard to researches which might be carried out in fresh-water lochs, and Sir John was asked to assure Mr. Pullar that the Council learned with much satisfaction that arrangements were in contemplation for carrying to a successful completion the admirable survey which had been commenced by Sir John and Mr. Pullar's son, Mr. F. P. Pullar, who was a member of the Society, and whose death they all deplored.

At the meeting of the British Association in Glasgow in September, 1901, the President of the Geographical Section (Dr. H. R. Mill) was enabled to announce that definite arrangements had been made to carry on the work; a conference of the Geographical, Geological, and Zoological Sections was held on September 16, 1901, for the purpose of considering the scheme of the survey; the discussion was taken part in by Dr. Mill, Prof. Bonney, Dr. John Horne, Mr. Isaac Thompson, Colonel Johnston, Mr. Ben. N. Peach, Mr. R. M. Clark, Prof. Watts, Mr. Barrow, Mr. Cunningham Craig, Mr. Dickson, Dr. Fullarton, Mr. W. S. Bruce, Mr. Greenly, and the Rev. Frank Knight, and many valuable suggestions were thrown out as to the scope of the work. At the conclusion of the discussion, Dr. Horne formally moved, on behalf of the meeting, the great gratification they all felt that this investigation should be carried out by means of the munificence of Mr. Pullar, and under the administration of Sir John Murray; the resolution was seconded by Mr. Peach, and unanimously adopted.

have given important assistance. A letter was received from Colonel Duncan A. Johnston, R.E., Director-General of the Ordnance Survey, stating that the Board of Agriculture had sanctioned the issue to the staff of the survey of two copies of the 6-inch and one copy of the 1-inch maps of the districts in which lakes were situated, one copy of the former to be returned to the department with the depths of the lakes laid down on it, with a view to the lake-contours being shown on the Ordnance Survey maps. T. Digby Piggott, Esq., C.B., Controller of His Majesty's Stationery Office, wrote to the effect that no objection would be raised by his department, on the ground of copyright, to the reproduction of Ordnance Survey maps, and publication if desired, in connection with

FIG. 3.—MEMORIAL BRONZE TO F. P. PULLAR, BY G. A. FRAMPTON, R.A., ERECTED IN LOGIE CHURCHYARD, BRIDGE OF ALLAN.

In the central group the hero is shown supported by angel figures, whose wings form a canopy and throw shadows symbolical of the mystery beyond; in front walk heralds carrying a laurel wreath, and behind others playing musical instruments. The legend is, "So He bringeth them unto their desired haven."

the Lake Survey, on the understanding that the source from which the reproductions are taken is quoted, and due acknowledgment be made of the fact that the consent of the Controller had been obtained. Admiral Sir W. J. L. Wharton, K.C.B., F.R.S., Hydrographer of the Admiralty, also promised the advice and assistance of his department. Through Mr. J. J. H. Teall, F.R.S., Director-General of the Geological Survey, and Dr. John Horne, F.R.S., Director of the Geological Survey of Scotland, Sir John Murray was informed that the Board of Education had sanctioned the issue to the Lake Survey staff of a complete set of the Geological Survey maps of Scotland, and, in addition, had sanctioned the supply of information which might be asked for by the staff of the Lake Survey during the course of their investigations. This latter privilege has been very largely taken advantage of, and Dr. Horne and

the other members of the Geological Survey in Scotland have rendered continuous advice and assistance, and have now given directions for the preparation of maps and notes concerning the surface geology of some of the areas in which the lakes are situated. These maps and notes will form a valuable part of the forthcoming publications.

All plans for carrying on the work having matured during the winter of 1901–2, a staff was appointed, and a start was made early in the spring of 1902, in the lochs situated in the more northerly part of the Tay basin, the survey being gradually extended to the lochs northwards of this region.*

During the summer of 1902, about 155 lochs were sounded, and the work has been continued during the present summer, over 300 lochs having now (July) been surveyed. It is, indeed, expected that the survey of all the lochs of the mainland of Scotland, together with those of the Outer Hebrides, Orkney, and Shetland, will be completed this year. As a rule, those lochs on which there are now no rowing-boats, or to which boats could not easily be transported, have been omitted in the meantime.

The methods employed in conducting these recent bathymetrical surveys have been essentially the same as those described in the paper communicated to the *Geographical Journal* in 1900.† The F. P. Pullar sounding-machine (see Fig. 4) has been used in all the larger lochs, but for the smaller lochs situated high up on the hills or otherwise difficult of access, several small machines (see Fig. 5) were constructed, which could be carried in the hand and easily fixed to the side of the rowing-boat. The line used was marked in feet in the usual way, and

---

* Mr. T. N. Johnston, M.B., C.M. (Edin.), F.R.S.E., was appointed first assistant and zoologist; Mr. James Parsons, B.Sc. (Lond.), chemist; Mr. James Murray, assistant zoologist; Mr. T. R. H. Garrett, B.A., Jesus College, Cambridge, geologist; Mr. John Hewitt, B.A., Jesus College, Cambridge, zoologist; Mr. James Chumley, secretary, assisted by Mr. Robert Dykes, in charge of office work. Mr. R. M. Clark, B.Sc., Aberdeen, also devoted a large part of the summer to field-work in connection with the survey, and assistance was also given for short periods by Dr. J. Sutherland Black, M.A., F.R.S.E., Sir John Jackson, LL.D., Mr. D. C. McIntosh, M.A., Mr. James Walker, C.E., and Mr. D. J. Scourfield.

During the last winter Mr. Parsons was appointed to a post on the Mineralogical Survey of Ceylon, and Mr. Garrett was appointed geologist to an East Borneo company. Their places on the staff have been taken by Mr. R. B. Young, M.A., and Mr. R. C. Marshall, M.A. In the summer of 1903 Mr. E. M. Wedderburn joined the staff, and also Mr. E. R. Watson, B.A., B.Sc., Jesus College, Cambridge, and Mr. Scourfield and others have rendered assistance. Among the boatmen who have been employed, Mr. Hugh Drummond deserves to be mentioned, as he has been continuously employed since the spring of 1902, and this summer Mr. Allan Grant and Mr. William Fraser have been continuously in the service of the Lake Survey. In June Mr. Young was appointed to a post in the South African College, and his place on the staff was taken by Mr. J. H. M. Wedderburn, M.A., F.R.S.E. During the present summer (1903) the staff numbers about fifteen in all.

† *Geogr. Jour.*, vol. xv. p. 311.

although the soundings took a much longer time, this small machine proved most satisfactory for hill lakes.

The 6-inch Ordnance Survey maps, supplied to the staff by the Ordnance Survey Office, have been used throughout, both in the field and office work. The positions of all the soundings were originally laid down on these maps. Tracings were then made on cloth, and the corrected soundings neatly written in at the correct positions, and the contour-lines of depth drawn. The areas within the various contour-lines were then ascertained by means of the planimeter, and the total bulk of water in the basin calculated from the data thus obtained. The maps to be published with this and succeeding papers are reduced to the scale of 3 inches to 1 mile (1 : 21,120). The soundings are given in feet; in some cases it was not possible to place all the soundings taken by the staff on the maps, because of their being too close together. The intervals between the contour-lines of depth are tinted with deepening shades of blue, the darkest shades indicating the greatest depths. The orographical relief of the loch basins has also been shown by contour-lines tinted with shades of brown, the darkening brown indicating the elevations. Longitudinal and cross-sections of the depths have been drawn for each loch. On these sections the black line of varying thickness along the top represents the true vertical relief drawn to scale, while the coloured extensions in outline represent the vertical scale five times exaggerated, in order to show the relative depth with greater effect.

The maps have been prepared under the direct superintendence of Mr. J. G. Bartholomew, F.R.S.E., who has taken great interest in the work, and has suggested lines of useful investigation. When the results of each river-basin are published, the tracings of the 6-inch maps above referred to, with the soundings on them, will be placed in the hands of the Director-General of the Ordnance Survey for preservation and future reference.

The late Sir Robert Menzies, the Marquis of Breadalbane, Sir John Stirling Maxwell, Donald Cameron, Esq., of Lochiel, Charles Murray, Esq., M.P., of Lochcarron, Lord Lovat, Sir John Ramsden, Sir Kenneth MacKenzie, H. C. Ross, Esq., Lord Zetland, and many other Highland proprietors, have taken great interest in the work of the survey. They have materially assisted, by the loan of boats and in other ways, in the progress of the survey; indeed, without their aid the amount of work reported above could not have been carried through.*

* Proprietors and others interested in the work of the Lake Survey, and desirous of possessing for their own use 6-inch maps of any of the lochs surveyed, with the soundings and contour-lines of depth laid down in position, can be supplied with copies on payment of the cost of the maps and of the office labour involved in transferring the data. Application should be made to Mr. James Chumley, Secretary of the Lake Survey, Challenger Office, 45, Frederick Street, Edinburgh.

A limnograph constructed after the designs of M. Ed. Sarasin, of Geneva, has been erected in the grounds of the St. Benedict's monastery at Fort Augustus, by the kind permission of the Lord Abbot, and is under the charge of Mr. E. M. Wedderburn. Up to the time of writing, Mr. Wedderburn reports that since June 18 the instrument has been continuously recording the rise and fall in the waters of Loch Ness. He has been able to recognize uninodal, binodal, quadrinodal, as well as transverse seiches. Several observations have been made at various points on the shore by means of the plemyrameter, and it is hoped in this way to determine the position of the nodes.

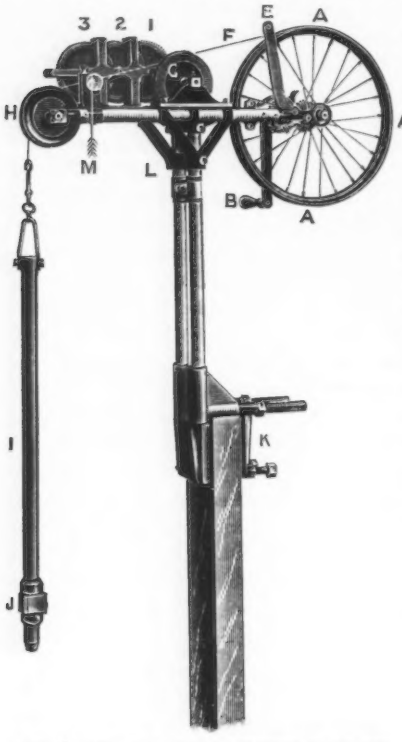


FIG. 4.—THE F. P. PULLAR SOUNDING-MACHINE.

Under the direction of Prof. Callendar, F.R.S., and Mr. Horace Darwin, F.R.S., instruments have been constructed, and are being erected at Fort Augustus by Mr. E. R. Watson, to carry out—

(*a*) Observations on the *daily variations of temperature* of the waters, by means of a series of platinum resistance thermometers (and Callendar's bolometers), with a view to obtaining, among other things—

(1) A measure of the amount of energy passing per day across unit area of the lake's surface.

(2) Some knowledge of the mechanism by which the water, especially in the deeper layers, is heated up and cooled off.

(*b*) Observations on the rate of leak of an electrically charged body on insulating supports in a vessel sunk to different depths, to ascertain—

(1) If water absorbs such radiations as effect the ionization of gases.

(2) If the deep waters are themselves radio-active.

(*c*) Observations on the limiting depth for visibility of a painted disc, and the relation between this depth and the zenith distance of the sun, the amount of organisms and of inorganic matter in the water, the temperature of the water, etc.

A number of biologists are now stationed at Fort Augustus, carrying out observations on the planktonic and benthonic organisms in the waters of Loch Ness, at the same time and place as the above-mentioned physical observations. It is thought that some insight may in this way be obtained into the interpretation of the varying physical conditions and the habits of the organisms.

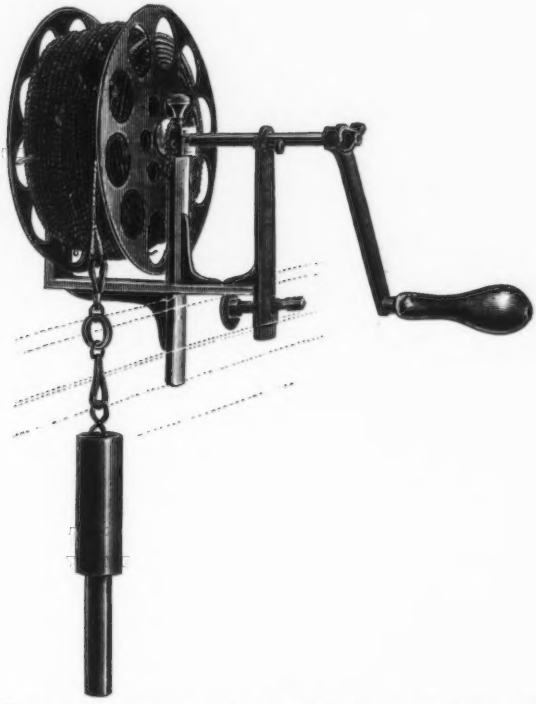


FIG. 5.—SMALL SOUNDING-MACHINE FOR USE IN SMALL AND SHALLOW LOCHS.

Arrangements have been made for the publication of the bathymetrical maps and the other observations of the Lake Survey staff in the *Geographical Journal*, the present communication being the first of the new series. It deals with a number of the lochs towards the headwaters of the main branches of the Tay basin. In addition to the maps, the paper is illustrated by photographs taken by the members of the staff and others.* It is hoped that the whole will, when completed, form a worthy memorial of the late Mr. F. P. Pullar, F.R.S.E.

* Sir John Murray would be greatly indebted to amateur photographers for copies of any photographs of the Scottish fresh-water lochs, with a view to their reproduction

Part III.—Lochs of the Tay Basin.

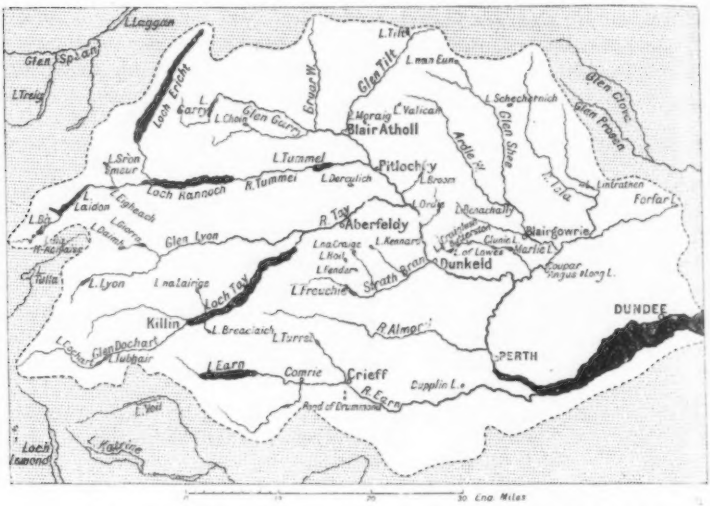


FIG. 6.—INDEX MAP OF THE TAY BASIN, BY J. G. BARTHOLOMEW, F.R.G.S.

Extent of the Tay Basin.—The whole area of the drainage basin of the Tay, including the estuary as far as a line joining Tents Muir Point with Monifieth, as measured with the planimeter on the 1-inch Ordnance Survey maps, is 2509·73 square miles.* Considerably more than one-fourth of this area drains directly into fresh-water lochs, of which there are seventy, including some of the largest in Scotland—Lochs Tay and Ericht, for instance, being over 14 miles in length, while eight of them exceed 2 miles in length.

The river-systems, which arise in the most mountainous and magnificent regions of Scotland, may be divided into four principal branches, viz. the Garry branch (the most northerly), the Tummel branch, the Tay branch, and the Earn branch (the most southerly).

(1) The Garry branch rises on the flanks of Beinn Mholach, Beinn

in the publications of the survey. Any selected for this purpose will be duly acknowledged. The copies of the photographs may be forwarded to Mr. James Chumley, Secretary of the Lake Survey, Challenger Office, 45, Frederick Street, Edinburgh.

* Geikie ('An Elementary Geography of the British Islands,' London, 1888, p. 86) gives the drainage basin of the Tay as 2250 square miles, and Lawson ('The Geography of River Systems,' London, N.D., p. 6) as 2400 [square] miles. According to Geikie, the Tay pours a larger volume of water into the sea than any other British river, and its drainage area is the largest in Scotland, and seventh in point of size in the British Islands, being exceeded by that of the Shannon in Ireland, the Thames, Severn, Ouse, Trent, and Great Ouse in England.

Bhoidheach, and Carn Beag an Laoigh, flowing by various streams into Loch Garry, thence by the river Garry into the river Tummel at Faskally, to the north-west of Pitlochry, receiving the waters of the Erochy at Struan, and those of the Tilt at Blair Atholl.

(2) The Tummel branch rises in the Black Mount, the westernmost of the sources of the Tay river-systems, flowing by the river Bà into Loch Buidhe, Lochan na Stainge, and Loch Bà, which receives the outflow from Lochan na h-Achlaise, thence flowing into Loch Laidon, thence into Loch Eigheach—an expansion of the river Gaur—receiving the waters from Lochan Sròn Smeur, and then flowing into Loch Rannoch, which receives the outflow from Loch Ericht, flowing finally into Loch Tummel, thence by the river Tummel into the river Tay at Logierait.

(3) The Tay branch rises on the flanks of Ben Lui (Beinn Laoigh), and flows by the river Fillan into Loch Dochart and Loch Iubhair, thence by the river Dochart into Loch Tay, being joined by the river Lochay at Killin just before entering Loch Tay; the outflow from Loch Tay is carried into the estuary of the Tay by the river Tay, which is joined shortly after leaving Loch Tay by the river Lyon, bearing the outflow from Loch Lyon, and further on (at Logierait) by the river Tummel, bearing the outflow from the Garry and Tummel branches, still further on (at Dunkeld) by the river Bran, bearing the outflow from Loch Freuchie, still further on (at Cargill) by the river Isla, and still further on, shortly before reaching Perth, by the river Almond.

(4) The Earn branch takes its rise at the heads of Glen Ogle and Gleann Ceann Droma, the two streams flowing into the west end of Loch Earn, which receives also the waters of the Ample burn, Beich burn, the Vorlich, the Tarken, and other smaller streams; the outflow from Loch Earn passes at St. Fillans into the river Earn, which receives the waters of the Ruchill and Lednock near Comrie, those of the Turret bearing the outflow from Loch Turret, near Crieff, and other smaller streams as it flows eastward to join the Tay at the head of the estuary.

In this and the next succeeding paper it is proposed to deal with the results obtained by the Lake Survey in the lochs of the Tay basin. The bathymetrical results will be given in detail in the first instance, and in the last paper on the Tay basin lochs the general biological and physical results will be given, together with a description of the geological character of the upper parts of the basin by Dr. John Horne, F.R.S., of the Scottish Geological Survey.

Maps and Illustrations.

The maps illustrating this paper are reduced from the 6-inch Ordnance Survey charts, and are published by permission of the Controller of H.M. Stationery Office.

Plate I. shows Loch Bà, Lochan na h-Achlaise, Lochan na Stainge, and Loch Buidhe, the contour-lines of depth being drawn in at 10 and 20 feet.

Plate II. shows Loch Laidon with Dubh Lochan, the contour-lines of depth being drawn in at 25, 50, 75, 100, and 125 feet.

Plate III. shows Lochan Sròn Smeur and Loch Eigheach, the contour-lines of depth being drawn in at 10 and 20 feet.

Plate IV. shows Loch Rannoch, the contour-lines of depth being drawn in at 50, 100, 200, 300, and 400 feet.

Plate V. shows Lochs Dochart and Iubhair, the contour-lines of depth being drawn in at 25 and 50 feet.

Plate VI. shows Loch Lyon, the contour-lines of depth being drawn in at 25, 50, 75, and 100 feet.

Plate VII. shows Loch Earn, the contour-lines of depth being drawn in at 50, 100, 200, and 250 feet.

In addition to the maps, there are fourteen woodcuts in the text; eight illustrating the character of the scenery around the lochs, another showing the Tay basin on a small scale, intended to serve as an index map, two others giving photographs of Sir John Murray and the late Mr. Fred. Pullar, taken during their last sounding trip together, another giving a photograph of bronze tablet in memorial to the late Mr. Pullar, another showing the F. P. Pullar sounding machine, and another showing new small sounding-machine for use in surveying small and shallow lochs.

1. *Lochs Ericht and Garry.*

These two lochs were sounded by Sir John Murray and the late Mr. Fred. Pullar in the spring of 1900, and the results were published in the *Geographical Journal* in March, 1901.*

2. *Rannoch Moor Lochs.*

No coach road in Britain probably passes through more magnificent scenery than that between the Bridge of Orchy and Ballachulish. About halfway between Inveroran Hotel and King's House Hotel the river Bà crosses the road, and to the west lies Corrie Bà, the sanctuary of the Black Mount forest, where no shot is ever fired, and consequently this splendid corrie is the home of the deer, the golden eagle, the fox, and other wild animals. Here also is the most westerly sources of the rivers of the Tay basin. In rainy weather a large amount of water passes down the river Bà and other streams into the Moor of Rannoch, and about a mile or two to the eastward of the road a large extent of the moor is flooded, and presents the appearance of a vast lake. In drier weather there are distinct basins, which have received the names of Loch Buidhe, Lochan na Stainge, Lochan na h-Achlaise, and Loch Bà (or A-baw), all of them situated in drift and encumbered with rocks

* *Geographical Journal*, vol. xvii. p. 289.

and small islands; they are all shallow. These lochs all contain trout, and have boats on them; they belong to the Marquis of Breadalbane, and are strictly preserved. On Eilean Molach in Loch Bà the heron still breeds in large numbers, and formerly the osprey used to breed in the same place. In making the survey of these lochs, the staff were much obliged to Mr. McIntyre, head stalker to the Marquis of Breadalbane.

*Loch Buidhe.**—Loch Buidhe (or Buie) is very shallow, and in places covered with weeds, though its surface is practically free from islands. It is somewhat quadrangular, though irregular, in outline, the maximum diameter (or length) from east to west being about one-third of a mile, and the maximum breadth from north to south about a quarter of a mile, the

FIG. 7.—MOOR OF RANNOCH, SHOWING LOCH BUIDHE AND LOCHAN NA STAINGE.
(*Photo by Sir John Murray.*)

mean breadth being about one-sixth of a mile. Its waters cover an area of about 35 acres, or one-nineteenth of a square mile, and it drains an area 222 times greater, or over 11 square miles. It is deepest towards the eastern shore, where the maximum depth (3 feet) was observed in several places, shoaling towards the western shore, off which the weeds are most abundant; the volume of water contained in it is estimated at 2,265,000 cubic feet. It was surveyed on April 15, 1902, by Messrs. Parsons, Clark, and McIntosh, about forty soundings being recorded. The surface of the water was determined by the Ordnance Survey officers in 1897 as being 981 feet above sea-level. The temperature of the surface water at 7 p.m. on April 15, 1902, was 48° Fahr.

* = Yellow loch.

*Lochan na Stainge.**—Lochan na Stainge (or na-Sting) is extremely irregular in outline, and includes three comparatively large islands as well as a number of small ones. Its length from north to south is over half a mile, the maximum breadth being two-fifths of a mile, and the mean breadth about one-seventh of a mile. Its waters cover an area of over 51 acres, or rather more than one-twelfth of a square mile, and it drains directly about two-thirds of a square mile, but since it receives the outflow from Loch Buidhe its total drainage area is nearly 12 square miles, or 147 times the area of the loch. The loch is divided into two portions by a barrier at the central constriction, on which there is only 1 foot of water, the maximum depth observed in the northern portion (between the large island and the northern shore) being 8 feet, while the maximum depth of the loch (14 feet) was found in the southern portion immediately to the south of the barrier referred to. The volume of water contained in the loch is estimated at 11,407,000 cubic feet, and the mean depth at 5 feet. The loch is on the whole shallow, nearly 99 per cent. of its floor being covered by less than 10 feet of water. It was surveyed on April 19, 1902, by Sir John Murray and Dr. Johnston, fifty-five soundings being recorded. The level of the loch was not determined by levelling, but on the new edition of the Ordnance Survey map (1897) there is a spot-level of 972 feet on the southern shore near the inflow, and another of 968 feet on the northern shore at the outflow, so that the surface of the water is probably about 970 feet above the sea. The drift-marks around the loch showed that it sometimes rises 5 feet higher than on the date surveyed, and during floods the whole valley looks like one loch, with knolls projecting above the water. The temperature of the surface water at 10.30 a.m. on April 19, 1902, near the boathouse, was 43°, and on returning to the same place at 12.30 (noon) it had risen to 46°·4; in the main basin, near the centre, the surface temperature was 42°·6, while the temperature of the air was 49°.

Lochan na h-Achlaise.†—Lochan na h-Achlaise (or na-Hachlich) is irregular in form, the outline being somewhat triangular or heart-shaped, with the apex pointing south. It includes many larger and smaller islands, and the bottom in the shallower places is covered by stones and boulders. The length from north to south is over four-fifths of a mile, while the maximum breadth from east to west is about three-quarters of a mile, the mean breadth being over one-third of a mile. Its waters cover an area of about 183 acres, or nearly three-tenths of a square mile, and it drains an area of over one square mile, or nearly four times the area of the loch. The north-western portion of the loch is shallow, the deeper water being found in the southern and eastern portions. The 10-feet basin is a continuous area, extending from near the southern shore in a northerly and then north-easterly direction to

* = Loch of the Stank or Fold. † = Loch in the Hollow.

near the north-eastern shore, excluding the islands lying off the eastern shore, and is nearly three-quarters of a mile in length. The 10-feet basin includes two 20-feet basins, the more southerly being the larger and deeper, the maximum depth of the loch (28 feet) having been found towards the north-eastern end of this basin, and comparatively close to the eastern shore. The volume of water contained in the loch is estimated at 76,236,000 cubic feet, and the mean depth at 9½ feet. The loch is on the whole comparatively shallow, about 63 per cent. of the bottom being covered by less than 10 feet of water, while only 9 per cent. of the bottom is covered by over 20 feet of water. The loch was surveyed on April 16, 1902, by Messrs. Parsons, Clark, and McIntosh,

FIG. 8.—LOCHAN NA H-ACHLAISE.
(*Photo by R. M. Clark, B.Sc.*)

over one hundred soundings being recorded. The surface of the water was found to be 962 feet above sea-level by the officers of the Ordnance Survey in 1897. The temperature of the surface water at 6 p.m. on April 16, 1902, was 45°·2.

*Loch Bà.**—Loch Bà (or A-baw) is extremely irregular in outline, studded with large and small islands, and with many rocks and boulders. Its length from south-west to north-east in a straight line is over 2 miles, and following the axis of deep water about 2½ miles. Its maximum breadth in the southern portion from east to west is over a mile, and the mean breadth is nearly half a mile. Its waters cover an area of about 585 acres, or nine-tenths of a square mile, and it drains directly

* = Cow loch.

an area of 4½ square miles, but since it receives the outflow from Loch Buidhe, Lochan na Stainge, and Lochan na h-Achlaise, its total drainage area is nearly 17½ square miles, or nineteen times the area of the loch.

The bottom of Loch Bà is very irregular. The deepest water occurs in the northern portion between the islands of Eilean Molach and Eilean na h-Iolaire, where there is a small basin less than a quarter of a mile in length and over 20 feet in depth, the maximum depth of 30 feet having been observed about one-sixth of a mile to the north of the northern point of Eilean Molach. An isolated sounding of 20 feet was taken close to the western shore of the southern portion of Eilean Molach. There are three irregular basins with depths exceeding 10 feet: the central one, enclosing the 20-feet basin, and extending on both sides of Eilean Molach and to the west and north of Eilean na h-Iolaire, is nearly three-quarters of a mile in length and over a quarter of a mile in breadth; the southern one, occupying the wide south-eastern portion of the loch, is nearly half a mile in maximum diameter; and the third, situated in the north-eastern extension of the loch, is nearly half a mile in length and nearly a quarter of a mile in breadth. The volume of water contained in the loch is estimated at 206,497,000 cubic feet, and the mean depth at 8 feet, being 27 per cent. of the maximum depth. The length of the loch is 378 times the maximum depth and 1402 times the mean depth. Over 70 per cent. of the floor of the loch is covered by less than 10 feet of water, and only 1½ per cent. by more than 20 feet of water. The loch was surveyed on April 17 and 18, 1902, by Sir John Murray and Dr. Johnston, over three hundred soundings having been taken. The level of the loch was determined by the Ordnance Survey officers in 1897 as being 957 feet above sea-level. The temperature of the surface water near the boathouse, when commencing the survey at 2.45 p.m. on April 17, was 50°·8 Fahr., but later, out in the open water, the surface temperature was 44°·2 Fahr.; on the 18th at noon the surface temperature near the shore was 50°·0 Fahr. (the air-temperature at the time being 50°·4 Fahr.), while in the bay to the north of the boathouse the temperature was 46°·0 Fahr.

Lochan Beinn Caorach* and some other small basins of water in this region were without boats and could not be sounded; they were evidently all quite shallow and of the same character as Loch Buidhe.

Loch Laidon.†—Loch Laidon (or Lydoch, or Luydan) lies partly in Perthshire and partly in Argyllshire, the boundary running along the centre of the western arm and for a certain distance up the main loch. It is one of the best trouting lochs in the district, or perhaps in Scotland. It is about 5⅓ miles in length from north-east to south-west, but it sends out an arm towards the west, which is over 1½ miles in length, and a line following the axis of the loch from the north-east end to the extremity of the western arm would be over 6 miles in length. Its

* = Loch of the Slopes. † = Loch of the Sheep-hill.

maximum breadth is nearly three-quarters of a mile, and the mean breadth about one-third of a mile, or 6·4 per cent. of the length. Its waters cover an area of about 1149 acres, or over $1\frac{3}{4}$ square miles, and it drains directly an area of $30\frac{1}{4}$ square miles; but, since it receives the outflow from Lochs Bà, Achlaise, Stainge, and Buidhe, its total drainage area is over $47\frac{1}{2}$ square miles, or $26\frac{1}{2}$ times the area of the loch. Nearly five hundred soundings were taken in the loch, and the

FIG. 9.—HERONS' NESTS ON EILEAN MOLACH IN LOCH BÀ.
(*Photo by T. N. Johnston, M.B., C.M., F.R.S.E.*)

maximum depth observed was 128 feet, the mean depth being 35 feet, or $27\frac{1}{2}$ per cent. of the maximum depth. The length of the loch is 219 times the maximum depth, and 795 times the mean depth. The volume of water contained in the loch is estimated at 1,761,733,000 cubic feet. The western extension and the southern end of Loch Laidon are filled with boulders and islets, and are like Loch Bà in character, but the main basin is of comparatively simple form, though with minor undulations of the lake-floor, the deepest water occupying the centre of the loch, where there is a basin three-quarters of a mile in length and

over 100 feet in depth, the maximum depth of 128 feet having been observed about $2\frac{3}{4}$ miles from the south-west end and $2\frac{1}{4}$ miles from the north-east end. Separated from this main 100-feet basin by shallower water, there is a sounding of 104 feet a short distance to the south-west, and half a mile further south there is an isolated sounding of 100 feet; there is also an isolated sounding of 100 feet a quarter of a mile to the north-east of the main basin. The principal 50-feet basin extends from less than a mile from the south-west end to less than $1\frac{1}{2}$ miles from the north-east end, and is nearly 3 miles in length. Separated from this larger basin by an interval of a quarter of a mile is a smaller one, about one-third of a mile in length, situated in the north-eastern part of the loch, and nearly midway between them is an isolated sounding of 50 feet. The western arm of Loch Laidon is shallow and filled with rocks and boulders, the greatest depth observed being 17 feet in three different places. Of the entire lake-floor, 53 per cent. is covered by less than 25 feet of water, 21 per cent. is covered by water between 25 and 50 feet in depth, 22 per cent. by water between 50 and 100 feet in depth, and 4 per cent. by water exceeding 100 feet in depth. Loch Laidon was surveyed on April 9 to 25, 1902, by Sir John Murray, Dr. Johnston, Messrs. Parsons, Clark, and McIntosh, and the surface of the loch was found by levelling to be 923·9 feet above sea-level. When surveyed by the Ordnance Survey officers on July 28, 1860, the level of the loch was 924·6 feet above the sea. At the north-eastern end of Loch Laidon is a small basin called Dubh Lochan,* which was found by levelling on April 14, 1902, to be 2 feet higher than Loch Laidon, and should, therefore, strictly speaking, be looked upon as a distinct lake, but in the foregoing description the two lakes have been regarded as one. Many temperature observations were taken in Loch Laidon on April 9, 10, 14, 15, and 25, the surface readings varying from 38°·8 at 5 p.m. on the 9th to 48°·2 at the head of the loch at 1 p.m. on the 10th—a range of 9°·6 in the temperature of the water, while the range in the air-temperature during the same period was only 5° (from 45°·2 to 50°·2). Two serial temperature observations were taken in the centre of the loch, the first at 5 p.m. on April 9, when the readings were identical (39°·8) at the surface and at depths of 5 and 25 feet, the second at 5.20 p.m. on the 10th, when the surface readings were 39°·8 and 41°, that at 5 feet 39°·7, and that at 20 feet 39°·4. The surface temperature in Dubh Lochan on April 14 was 43°·9.

The western arm of Loch Laidon receives the waters from a small loch (Lochan Gaineamhach)† lying about 2 miles to the west. This loch, and the neighbouring one to the north, were visited on May 20, 1903, but, as there were no boats on them, they were not sounded. They were found to be of the same general character as the other

* = Black Lochan. † = Loch of sandy beaches.

lochs of Rannoch Moor—shallow, with stony shores, containing boulders and islets, some of the latter with small trees on them. In Lochan Gaineamhach, weeds were seen only in some very small bays, but in the other lochan weeds were seen in several places, with a little open water in the eastern half.

To the north of the north-eastern end of Loch Laidon lies the little Lochan a' Chlaidheimh,* where three counties (Perthshire, Argyllshire, and Inverness-shire) meet. This lochan was visited on May 14, 1902, but was not sounded, as there was no boat on it. It is evidently very shallow in all parts, full of rocks and boulders, a rock showing above

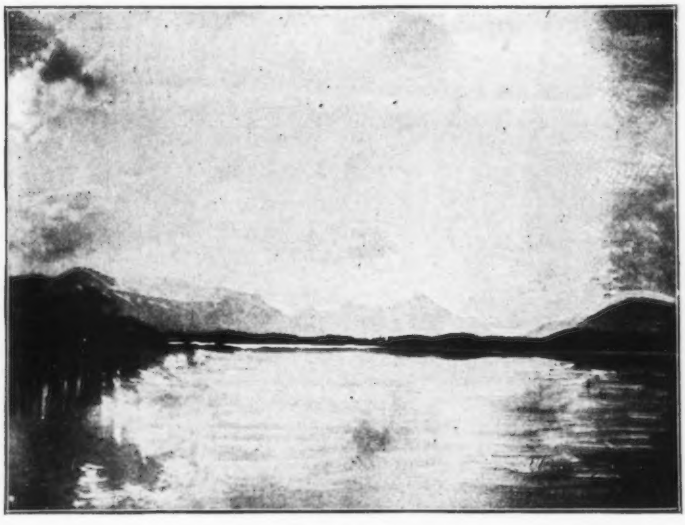


FIG. 10.—LOCH LAIDON.
(*Photo by Miss Margaret Murray.*)

water even in the very centre, and all along the shores rocks are numerous, extending in lines out from the shore. A couple of miles to the east of Lochan a' Chlaidheimh lies Lochan Sròn Smeur, next to be dealt with, on which there was a boat.

Lochan Sròn Smeur.†—Lochan Sròn Smeur (or Sròn-Smear) is situated a little to the east of the road running from Rannoch to Loch Ossian, and is said to contain small black trout, but is strictly preserved. It is over half a mile in length, less than a quarter of a mile in maximum breadth, the mean breadth being one-seventh of a mile, or 25 per cent. of the length. Its waters cover an area of over 50 acres (or about one-

* = Loch of the Swor † = Loch of the Marrow Point.

twelfth of a square mile), and it drains an area of nearly 2 square miles, nearly twenty-four times the area of the loch. It was surveyed on May 12, 1902, by Sir John Murray and Mr. James Murray, who took about seventy soundings, the maximum depth observed being 33 feet. The volume of water contained in the lake is estimated at 22,592,000 cubic feet, and the mean depth at 10·3 feet, or 31 per cent. of the maximum depth. The loch is of simple conformation, the western half being comparatively shallow, while the deeper water occurs in the eastern half, the maximum depth having been found about one-eighth of a mile from the eastern end. The 10-feet basin approaches quite close to the eastern shore, and is about one-third of a mile in length, enclosing the 20-feet basin, which is about one-fifth of a mile in length. About 61 per cent. of the lake-floor is covered by less than 10 feet of water, while about 12 per cent. is covered by over 20 feet of water. No bench-marks were found near the loch, but a little distance up the river which feeds it there is a spot-level of 1134 feet. There was little evidence of much rise and fall in the level of the water, the range possibly not exceeding 2 feet. The temperature of the surface water varied from 47°·4 to 50°·5, a range of 3°·1, the higher readings being taken in shallow water near shore. Readings at 10 feet and at 20 feet near the centre of the loch gave 48° in each case, the surface temperature at the same time being 47°·6.

Less than a mile to the east of Lochan Sròn Smeur is Lochan Lòin nan Donnlaich* (or Lochan Lòin nan Dubhach, or Loch-an-Londonich), said to contain large trout. When visited, many rocks and boulders were observed showing above the water, and grass filled the bay at the outlet.

Loch Eigheach.†—Loch Eigheach (or Eaigh), about 3 miles from where the river Gaur passes its waters into Loch Rannoch, is an expansion, or rather three expansions, of the river Gaur, the two western expansions lying on a higher level than the eastern one, and hence strong currents run in an easterly direction. In high floods the whole area is practically submerged. A large part of the loch is covered by reeds, and the bottom is very weedy. The entire loch is nearly nine-tenths of a mile in length, with a maximum breadth of less than a quarter of a mile, the mean breadth being one-tenth of a mile. Its waters cover an area of about 59½ acres, or less than one-tenth of a square mile, and it drains directly an area of nearly 14 square miles, but since it receives the outflow from Lochan Sròn Smeur and from Lochs Laidon and Bà, etc., its total drainage area is nearly 63½ square miles, or 705 times the area of the loch. The loch was surveyed by Dr. Johnston on April 21, 1902, about eighty soundings being recorded, the maximum depth observed being 28 feet. The surface of the eastern expansion was found by levelling to be 818·2 feet above sea-level, and the water apparently rises about 3½ feet above

* = Loch of the Macdonald's Field. † = Loch of the Cry (?).

its level on the date surveyed. The volume of water contained in the loch is estimated at 15,794,000 cubic feet, and the mean depth at 6 feet, or 22 per cent. of the maximum depth. The eastern expansion is the deepest, the maximum depth of 28 feet having been found to the west of the island near the east end of this expansion; the north-western expansion has a maximum depth of 7 feet observed not far from the outlet, but the majority of the soundings run from 2 to 5 feet; the south-western expansion is the shallowest, with a maximum depth of 3

FIG. 11.—LOCHAN SRÒN SMEUR.
(*Photo by H. C. Lamb.*)

feet to the west of the central large island (Eilean na Coille), the bottom to the east and south of that island being covered by only 1 foot of water. Over 90 per cent. of the entire lake-floor is covered by less than 10 feet of water, and less than 2 per cent. by over 20 feet of water. The surface temperature in the eastern expansion at 11 a.m on April 21, 1902, was 44°·2, the air-temperature at the time being 49°·5.

3. *Loch Rannoch.**

Loch Rannoch, one of the larger and more important of the lochs in the Tay basin, was the headquarters of the Lake Survey for nearly four months, from March 20 to July 10, 1902, and during that period a great many soundings, as well as observations on the temperature of the water, on the biology, and on the rise and fall of the surface of the loch, were taken, all the members of the staff taking part in the work. The lake trends in an east-and-west direction, and is a lovely sheet of water, the

* = Loch of the Ferns.

hills on both sides, and the woods clothing its shores in many places, adding beauty to the scene. The famous Black Wood of Rannoch on the south side is of great antiquity. The loch contains many small trout, and is famed for large *Salmo ferox*. It is nearly $9\frac{3}{4}$ miles in length, considerably over a mile in maximum breadth, the mean breadth being about three-quarters of a mile, or about 8 per cent. of the length. Its waters cover an area of over 4700 acres, or nearly $7\frac{1}{2}$ square miles, and it drains directly an area of about 130 square miles, but since it receives the outflow from Loch Ericht, Loch Eigheach, Loch Laidon, Loch Bà, etc., its total drainage area is about $243\frac{1}{2}$ square miles, or 33 times the area of the loch.

Over eight hundred soundings were taken in Loch Rannoch, the maximum depth observed being 440 feet, or 20 feet deeper than the maximum depth recorded by Mr. Grant-Wilson during his survey in the year 1888, when he took about 320 soundings. The volume of water contained in the loch is estimated at about 34,387,131,000 cubic feet, or less than a quarter of a cubic mile, and the mean depth at $167\frac{1}{2}$ feet, or 38 per cent. of the maximum depth. The length of the loch is 116 times the maximum depth, and 306 times the mean depth. The loch is widest and deepest in the eastern half, narrowing and shallowing towards the west on approaching the island Eilean nam Faoileag, then deepening again to the west of that island. It consists of one large main basin, with two subsidiary small basins over 50 feet in depth towards the west end, separated from the main basin by the shallow water in the neighbourhood of Eilean nam Faoileag. The larger of the two subsidiary basins is about three-quarters of a mile in length, stretching from south of the island An t-Eilean Fearna, at the entrance of the river Ericht, towards the west end of the loch, and the maximum depth recorded in it was 84 feet; the smaller basin lies between the two islands mentioned and towards the northern shore, soundings of 52 and 54 feet having been obtained therein. The main 50-feet basin is about $7\frac{3}{4}$ miles in length, occupying the great body of the loch east of Eilean nam Faoileag, and covering an area exceeding 5 square miles. The 100-feet basin is nearly 7 miles in length, extending from between the mouths of the Killichonan Burn and the Allt Camghouran towards the east end of the loch. The 200-feet basin is 6 miles in length, stretching from within a quarter of a mile from the east end to opposite the house Talla Bheith on the northern shore. The main 300-feet basin is nearly 4 miles in length, stretching from less than half a mile from the east end to opposite Dall on the southern shore, and separated from it by an interval of a quarter of a mile is an isolated sounding of 304 feet. Within the 300-feet basin the bottom sinks in three places along the central axis of the loch below the 400-feet line. The easternmost of these three 400-feet basins is the largest and deepest, situated about $1\frac{1}{4}$ miles from the east

end, about two-thirds of a mile in length, and enclosing the maximum depth of the loch (440 feet); a short distance to the west (opposite Craiganour) is a second small basin based upon a sounding of 404 feet; and three-quarters of a mile farther west is the third basin, with a maximum depth of 421 feet. The area of the lake-floor covered by less than 50 feet of water is about 1200 acres (nearly 2 square miles), or 25 per cent. of the total area, while the area between the 50-feet and 100-feet lines is about 750 acres, or 16 per cent., showing a relatively rapid

FIG. 12.—LOCH RANNOCH.
(*Photo by Miss McPherson.*)

descent beyond the 50-feet line. The area between the 100- and 200-feet lines is about 877 acres, or nearly 19 per cent. of the entire area. The area between the 200- and 300-feet lines is about 950 acres, or over 20 per cent. The area between the 300- and 400-feet lines is about 875 acres, or $18\frac{1}{2}$ per cent., and that over 400 feet about 65 acres, or nearly $1\frac{1}{2}$ per cent. of the total area of the loch.

On commencing the survey of Loch Rannoch, the height of the surface above sea-level was determined from Ordnance Survey bench-marks as 668 feet; the level of the loch fluctuated during the progress

of the survey, but the soundings have all been reduced to this datum. The officers of the Ordnance Survey on July 19, 1860, found the level of the loch to be 667·5 feet above the sea.

Very many temperature observations were taken between March 20 and July 10, 1902. The surface temperatures need not be discussed in detail; the lowest reading recorded was 37°·9 on March 28, and the highest 59°·8 on June 23, showing a range of 22° in the temperature of the surface water during the period of three months. An interesting series of hourly observations on the temperature of the air and of the surface water at the pier at Rannoch Lodge was taken on June 9. One thermometer was immersed in 3 feet of water outside the pier, and another in 1 foot of water inside the pier, and they were read simultaneously with an air-thermometer at intervals of one hour from 9 a.m. to 10 p.m. The temperature of the air rose gradually, though irregularly, from 48° at 11 a.m. to a maximum of 53° at 4 p.m., falling gradually again to 44°·5 at 9 p.m., and 45° at 10 p.m. The thermometer in 3 feet of water showed a gradual rise in the temperature from 51°·9 at 9 a.m. to 53° at 11 a.m., then a slight fall at noon (52°·7) and at 1 p.m. (52°·5), the maximum (53°·6) being recorded at 2 p.m., falling to 52°·9 at 4 p.m., rising to 53°·3 at 5 p.m., falling gradually to 52°·1 at 8 p.m., then rising to 52°·8 at 9 p.m., and 53° at 10 p.m. The thermometer in 1 foot of water showed a gradual rise in the temperature from 51°·4 at 9 a.m. to the maximum of 53°·6 at 2 p.m., whence it fell gradually to 51°·5 at 9 p.m., the reading at 10 p.m. being 52°. The maximum temperature of the water was recorded in each case at 2 p.m., while the maximum temperature of the air was recorded at 4 p.m., and the temperature of the air was always lower than that of the water, except when the air was at its maximum (53° at 4 p.m.), the thermometer in 3 feet of water then reading 52°·9, while that in 1 foot of water read 53°·3. The temperature recorded in 1 foot of water was lower than that recorded in 3 feet of water in the forenoon and late evening, but at noon and 1 p.m. it was higher, at 2 p.m. and 3 p.m. it was identical, and from 4 p.m. till 8 p.m. it was higher, the greatest difference recorded being 1° 3 at 9 p.m. (52°·8 at 3 feet, and 51°·5 at 1 foot).

The temperatures taken beneath the surface have been collected together and arranged chronologically in the opposite table, which may be useful for future reference and comparison. The great majority of them were taken in the small 80-feet basin towards the west end of the loch, while one series was taken near the east end on April 3, and three series were taken towards the middle of the loch, opposite Craiganour, on May 1, 2, and 23. The table shows well the heating up of the water with the advance of summer. The readings taken near the west end in March are all below 39° Fahr.—that is, below the maximum density point, though surface temperatures exceeding 39°, and in one or two cases exceeding 40°, were recorded

SERIAL TEMPERATURES TAKEN IN LOCH RANNOCH.

Depth. Feet.	22/3/02. West end.	26/3/02. 2.30 p.m. West end.	26/3/02. 3.30 p.m. West end.	28/3/02. 4 p.m. Five miles from West end.	2/4/02. 3.39 p.m. West end.	3/4/02. 4.15 p.m. Three-quarters mile from Kinloch Rannoch.	8/4/02. 4.15 p.m. West end.	9/4/02. 11.35 a.m. West end.	9/4/02. 5 p.m. West end.	10/4/02. 7 a.m. West end.	21/4/02. 3.30 p.m. West end.	1/5/02. Afternoon. Opposite Craigenour.	2/5/02. Craigenour.	3/5/02. 6 p.m. West end.	23/5/02. 11 a.m. West end.	23/5/02. 4 p.m. Opposite Craigenour.	29/5/02. 7.15 p.m. West end.	6/6/02. West end.	7/6/02. 10 a.m. West end.	7/6/02. 8 p.m. West end.	21/6/02. 6.30 p.m. West end.
	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
Surface	38·4	38·8	38·0	38·9	39·4	38·9	42·3	39·9	39·7	39·3	45·8	41·4	41·2	45·3	47·3	42·0	48·3	50·0	48·8	49·8	52·0
3	—	—	—	—	—	—	—	—	—	39·8	—	—	—	—	—	—	—	—	—	—	—
5	—	—	38·0	—	—	—	—	—	—	39·5	45·8	41·8	—	45·2	—	—	—	50·0	48·8	—	52·0
10	—	38·3	38·0	—	39·4	39·0	—	39·8	—	39·5	45·0	41·7	41·2	—	—	42·0	48·0	49·5	48·9	50·0	52·0
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	48·8	—	49·0	—
20	—	38·3	—	—	39·4	38·9	—	39·7	—	39·5	43·2	41·6	41·2	—	47·3	42·1	48·0	—	48·8	—	51·3
23	—	—	—	38·3	—	—	—	—	—	—	—	—	—	—	—	—	—	48·4	—	47·6	—
25	—	—	—	—	—	—	—	—	—	—	—	41·3	—	45·0	—	—	—	—	48·5	—	51·0
30	38·6	38·3	—	—	—	—	39·9	39·8	—	—	—	41·3	—	—	—	—	—	—	48·2	—	—
32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35	—	—	—	—	—	—	—	—	—	—	—	—	—	—	47·2	—	—	48·9	47·2	—	—
40	—	38·3	37·9	—	39·4	38·9	39·8	39·6	39·6	39·6	—	—	—	—	47·2	—	48·0	—	47·2	46·9	—
45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	47·2	42·1	—	—	—	—	—
50	—	38·3	—	—	—	—	39·9	40·0	39·6	39·5	43·0	41·3	—	45·0	47·2	—	—	—	46·8	46·4	49·9
60	—	38·3	37·9	—	—	—	—	40·0	—	—	—	—	—	—	46·9	—	—	—	—	—	—
70	38·8	38·3	—	—	—	—	39·8	40·0	—	39·4	43·0	—	—	44·1	46·9	42·2	—	—	—	—	47·0
75	—	—	—	—	39·3	—	—	—	39·3	—	—	—	—	—	—	—	—	—	46·3	46·1	—
80	—	—	—	—	—	—	—	40·0	—	39·3	42·8	—	—	—	—	—	—	—	—	—	—
100	—	—	—	—	—	38·9	—	—	—	—	—	40·3	40·8	—	—	41·9	—	—	—	—	—
200	—	—	—	—	—	38·9	—	—	—	—	—	40·0	40·2	—	—	—	—	—	—	—	—
300	—	—	—	—	—	—	—	—	—	—	—	40·0	—	—	—	—	—	—	—	—	—

nearer the shore during the last days of March. On April 2 and subsequently, the temperature was above that of maximum density (39°·1), but the observations taken near the east end on April 3 showed that the temperature of the water from surface to bottom was just below maximum density point. The water in the small western basin had a temperature under 40° up to April 10, and was practically uniform from top to bottom, but on April 21 and subsequently the temperature rose, and there was a considerable range between the temperature of the upper and lower layers. The water in the main basin had a temperature of 40° at 200 and 300 feet on May 1; on May 2 the temperature was 40°·2 at 200 feet; and on May 23 it was 41°·9 at 100 feet. By the beginning of June the water near the surface had attained a temperature of 50°, and by June 21 that temperature extended down to 50 feet, the upper 10 feet having on that date a temperature of 52°.

4. *Loch Lyon.*

Loch Lyon lies at a high elevation at the head of Glen Lyon, amid grand and mountainous scenery, its waters being carried by the river Lyon into the river Tay a short distance above the mouth of Loch Tay; it contains both salmon and trout. It trends in a north-east and south-west direction, and is extremely simple both in outline and in the conformation of the bottom. It is of nearly uniform width, except for a cone of alluvium, brought down by the river, on the south-eastern shore. It is about 1¾ miles in length, with a maximum breadth of over a quarter of a mile, the mean breadth being over one-fifth of a mile, or 12 per cent. of the length. Its waters cover an area of about 236 acres, or over one-third of a square mile, and it drains an area of over 10½ square miles, an area nearly twenty-nine times greater than that of the loch. Over one hundred soundings were taken in Loch Lyon, the maximum depth observed being 100 feet. The volume of water contained in the loch is estimated at about 460,750,000 cubic feet, and the mean depth at 45 feet, or 45 per cent. of the maximum depth. The length of the loch is 92 times the maximum depth, and 205 times the mean depth. As stated, the loch forms a simple basin, the bottom sinking gradually on all sides towards the deepest part, which is approximately centrally placed. The deep water, however, approaches much closer to the south-west end than to the north-east end, where the 25-feet line is distant about a quarter of a mile from the shore, probably through silting up of the lake-floor at that end. The 25-feet basin is nearly 1½ miles in length, the 50-feet basin is about 1⅓ miles in length, and the 75-feet basin is about 1⅙ miles in length. The area of the lake-floor covered by less than 25 feet of water is about 92 acres, or 39 per cent. of the total area of the loch; the area between the 25- and 50-feet contour-lines is about 36 acres, or over 15 per cent.; the area between the 50- and

75-feet contours is about 55 acres, or over 23 per cent.; and the area over 75 feet in depth is about 53 acres, or less than 23 per cent. of the entire area of the loch. The comparatively flat-bottomed character of the deep basin is indicated by the larger proportion of the bottom covered by water between 50 and 75 feet in depth, as compared with the proportion covered by water between 25 and 50 feet, the average slope being thus considerably steeper in depths of 25 to 50 feet than in

FIG. 13.—LOCH LYON.
(*Photo by Sir John Murray.*)

depths of 50 to 75 feet; and this latter gentler slope is continued into the deeper water over 75 feet in depth, as shown by the nearly equal areas on both sides of the 75-feet line. The large proportion under 25 feet in depth is due to the considerable silted-up area towards the north-east end of the loch, already referred to. Loch Lyon was surveyed by Sir John Murray, Dr. Johnston, and Mr. Parsons on May 10, 1902. No bench-marks were to be seen along the shores, nor on the Ordnance Survey charts, but the height of the surface of the loch was estimated as being about 1050 feet above the sea. Lines of drift were observed 4 feet above the water, which, according to the keeper, was about its

normal height at the time of the survey; the water rises suddenly and falls as quickly, and might fall perhaps a foot lower than on the date of the survey. Thus a range of about 5 feet in the level of the water is indicated. The temperature of the surface water on May 10, 1902, when commencing the survey, about noon, was 48°·7 at the edge of the bank at the north-east end (the temperature of the air at the time being 46°·4), and readings taken along the shore gave 50°, 51°·8, 52°·5, and 58°. In the afternoon, readings of 47°·9 were taken in shallow water towards the northern shore, 48°·9 near the south-west end, and 46°·4 in the centre of the loch. These observations show a range of 11°·6 in the temperature of the surface water throughout the day, viz. from 46°·4 to 58°.

5. *Lochs Dochart and Iubhair.*

Loch Dochart.—Loch Dochart, situated at the foot of Ben More amid beautiful scenery, is the westernmost of the lochs belonging to the Tay branch of the Tay river-system, being evidently an expansion of the river Fillan, which forms the headwaters of this branch. It receives the drainage from a considerable tract of country, is very shallow, the bottom is very weedy, and there are many reeds, especially at the west end. Loch Dochart is nearly two-thirds of a mile in length, with a maximum breadth of nearly one-sixth of a mile, the mean breadth being over one-tenth of a mile, or 18 per cent. of the length. Its waters cover an area of about 46 acres, or nearly one-fourteenth of a square mile, and it drains an area of nearly 39 square miles, or 555 times the area of the loch. Nearly seventy soundings were taken in Loch Dochart, the maximum depth observed being 11 feet; but this depth is of very limited extent, only two isolated soundings being recorded near the west end of the loch, while by far the greater portion of the bottom is covered by less than 5 feet of water. The volume of water contained in the loch is estimated at 10,032,000 cubic feet, and the mean depth at 5 feet, or 46 per cent. of the maximum depth. The length of the loch is 298 times the maximum depth, and 652 times the mean depth. Loch Dochart was surveyed by Dr. Johnston and Mr. Parsons on April 28, 1902, and the level of the surface of the water was determined from Ordnance Survey bench-mark as being 513 feet above sea-level. The temperature of the surface water at 11.30 a.m. on that date was 50°·1, the temperature of the air at the same time being 49°.

*Loch Iubhair.**—Loch Iubhair (or Nubhair) receives the outflow from Loch Dochart by a river considerably less than half a mile in length, so that they may almost be regarded as forming one lake. It affords fair trout-fishing, and the scenery round about is very beautiful. Loch Iubhair is about $1\frac{1}{3}$ miles in length, with a maximum breadth of about one-third of a mile, the mean breadth being nearly one-sixth of a mile,

* = Loch of the Yew-trees.

or 12 per cent. of the length. Its waters cover an area of about 135½ acres, or over one-fifth of a square mile, and it drains directly an area of about 5¾ square miles; but, since it receives the outflow from Loch Dochart, its total drainage area is over 44½ square miles, or 212 times the area of the loch. Over one hundred soundings were taken in Loch Iubhair, and the maximum depth observed was 65 feet. The volume of water contained in the loch is estimated at 147,284,000 cubic feet, and the mean depth at 25 feet, or 38 per cent. of the maximum depth. The length of the loch is 110 times the maximum depth, and 286 times the mean depth. Loch Iubhair trends in a north-east and south-west

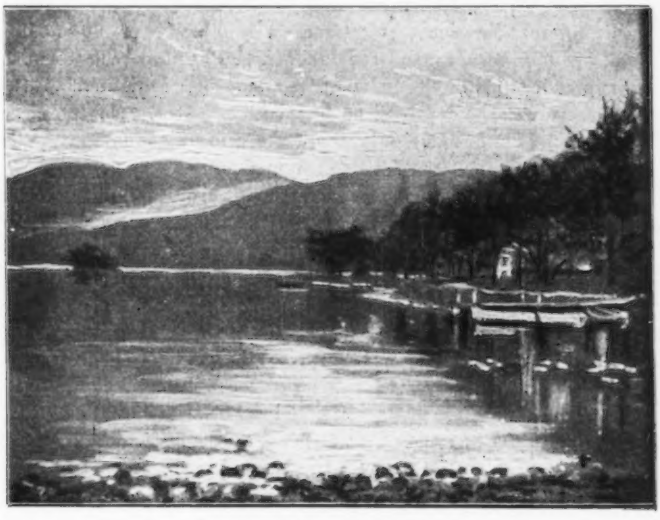


FIG. 14.—LOCH EARN.

(Photo by J. Parsons, B.Sc.)

direction, and is rather peculiar in outline, resembling somewhat the italic letter *f*, constricted in the central portion, where a ridge crosses the loch with a maximum depth of 36 feet on it. The loch widens and deepens on each side of this constriction, the maximum depth of the loch having been found in the north-eastern part, where the loch is widest, the greatest depth observed in the south-western part being 49 feet. The 25-feet basin is a continuous area over a mile in length, approaching close to the northern shore, but distant about a quarter of a mile from the south-west end. The area of the lake-floor covered by less than 25 feet of water is about 72 acres, or 53 per cent. of the total area of the loch; the area between the 25- and 50-feet contours is about 59 acres, or 44 per cent., while the area covered by over 50 feet of water

is about 5 acres, or 3 per cent. of the entire area of the loch. Loch Iubhair was surveyed by Dr. Johnston and Mr. Parsons, at the same time as Loch Dochart, on April 28, 1902, the level of its surface being a foot lower than that of Loch Dochart, viz. 512 feet above the level of the sea.

6. *Loch Earn.**

Loch Earn is situated amid lovely surroundings, the hills on both sides being clothed with rich woods, and splendid mountain scenery bounds the horizon towards the west, while on the south Ben Voirlich towers to a height of 3200 feet. It contains trout and salmon, and also *Salmo ferox*. It has been said that the loch is 100 fathoms (= 600 feet) deep in some places, but this is disproved by the soundings taken by different surveyors. Mr. Grant-Wilson took over 180 soundings in 1888, Sir John Murray and the late Mr. F. P. Pullar took about 150 soundings in 1900, and the Lake Survey took 500 soundings in 1902, but in no case was the depth found to exceed 288 feet. On the accompanying map (Plate VII.) only the Lake Survey soundings are laid down, and the contour-lines drawn in from them.

Loch Earn is $6\frac{1}{2}$ miles in length, and four-fifths of a mile in maximum breadth, the mean breadth being three-fifths of a mile, or $9\frac{1}{2}$ per cent. of the length. The waters of the loch cover an area of over 2400 acres, or nearly 4 square miles, and it drains an area of over $54\frac{1}{2}$ square miles—an area fourteen times greater than the area of the loch. Five hundred soundings were taken in Loch Earn, the maximum depth observed being 287 feet, which agrees very well with the maximum recorded by Mr. Grant-Wilson in 1888, viz. 48 fathoms, or 288 feet. The volume of water contained in the loch is estimated at 14,420,638,000 cubic feet, and the mean depth at 138 feet, or 48 per cent. of the maximum depth. The length of the loch is 118 times the maximum depth, and 245 times the mean depth.

Loch Earn forms a simple basin, the lake-floor sinking gradually on all sides down to the greatest depth, as is well shown by the longitudinal and three cross-sections on the map. The 50-feet contour-line follows approximately the outline of the loch, approaching very close to the west end, where between the mouths of the Ogle and Kendrum burns a sounding of 57 feet was taken about 300 feet from the shore, giving a slope of 1 in 5·3. At the opposite end of the loch the 50-feet contour is met with about one-third of a mile from the bridge across the river at St. Fillans. The 100-feet basin approaches to within less than a quarter of a mile from the west end, and less than half a mile from the east end, and is over $5\frac{3}{4}$ miles in length; it covers an area of nearly $2\frac{1}{3}$ square miles. The 200-feet basin is $4\frac{1}{2}$ miles in length, stretching from three-quarters of a mile from the west end to $1\frac{1}{4}$ miles from the east end, and covers an area of $1\frac{1}{8}$ square miles. The 250-feet basin is nearly 2 miles

* Earn = water.

in length, and a quarter of a mile in maximum width, extending from $1\frac{1}{2}$ miles from the west end to 3 miles from the east end. The maximum depth of 287 feet was observed near the centre of the loch, between the mouths of the Allt Bhacaidh on the north and the Allt Dhùnain on the south, about $2\frac{3}{4}$ miles from the west end, and $3\frac{3}{4}$ miles from the east end. The area of the lake-floor covered by less than 100 feet of water is about 926 acres, or $38\frac{1}{2}$ per cent. of the total area of the loch. The area between the 100- and 200-feet contour-lines is about 755 acres, or $31\frac{1}{2}$ per cent., and the area covered by more than 200 feet of water is about 700 acres, or 30 per cent. The flat-bottomed character of the loch is indicated by the last-mentioned percentage, which is nearly equal to the preceding one, though the interval of depth is only 87 feet as compared with the previous interval of 100 feet. The comparatively uniform average slope from the shore down to a depth of 100 feet is shown by the fact that the areas on each side of the 50-feet line are nearly equal, viz. 477 acres (or nearly 20 per cent. of the entire area of the loch) between the shore and the 50-feet contour, and 449 acres (or nearly 19 per cent.) between the 50- and 100-feet contours.

Loch Earn was surveyed by Messrs. James Parsons and James Murray on May 14 to 19, 1902, and the level of the surface of the water was determined by levelling from Ordnance Survey bench-mark as 317·2 feet above sea-level. This is identical with the level determined by the surveyors of the Ordnance Survey on August 25, 1899.

On May 14, at 3.45 p.m., the temperature of the surface water near Lochearnhead was 46°·1 (the air-temperature being 48°); at 6 p.m. the surface temperature was 44°, and at 7 p.m. near shore 47°·2. On May 15, at 11.30 a.m., the surface temperature near shore, about a mile east of Lochearnhead, was 44° (the air-temperature being 40°·5). On May 16, at 10.30 a.m., the surface temperature at the St. Fillans end of the loch was 44°·1 (the temperature of the air at the time being 45°), and at 1.30 p.m. it was 44°. On May 17, at 5 p.m., the surface temperature off Dalkenneth over the deepest part of the loch was 43°·8 (the air-temperature at the time being 47°·7). The range observed in the temperature of the surface water during those four days was thus 3°·4, from 43°·8 to 47°·2, the range in the air-temperature during the same period being 7°·5, from 40°·5 to 48°.

A series of temperatures beneath the surface was taken in the deepest part of the loch on May 17, at 5 p.m., with the following results:—

Surface	43°·8 Fahr.
5 feet	43°·5 "
10 "	43°·4 "
20 "	43°·3 "
30 "	43°·2 "
50 "	43° 2 "
100 "	43°·1 "
125 "	42°·3 "
150 "	42°·1 "
200 "	42°·0 "
250 "	41°·5 "

SUMMARY TABLE.

Giving details concerning the Lochs described in this Paper.

Loch.	Height above sea. Feet.	Number of soundings.	Length in miles.	Breadth in miles.		Mean breadth per cent. of length.	Depth.			Ratio of depth to length.		Volume in million cubic feet.	Area in square miles.	Drainage area.	
				Max.	Mean.		Max. feet.	Mean feet.	Mean per cent. of max.	Max.	Mean.			Total in square miles.	Ratio to area of loch.
Buidhe	981·0	39	0·32	0·24	0·16	50·0	3	1·500	50·0	563	1126	2	0·05	11·12	222·40
na Stainge	966·5	55	0·54	0·40	0·15	27·8	14	5·097	36·4	204	559	11	0·08	11·79	147 37
na h-Achlaise	962·0	112	0·82	0·76	0·35	42·7	28	9·580	34·2	155	452	76	0·29	1·08	3·72
Bà	957·0	315	2·15	1·02	0·43	20·0	30	8·098	27·0	378	1402	206	0·92	17·41	18·92
Laidon and Dubh Lochan	923·9	486	5·30	0·70	0·34	6·4	128	35·194	27·5	219	795	1,762	1·80	47·66	26·43
Sròn Smeur	—	68	0·56	0·22	0·14	25·0	33	10·310	31·2	90	287	23	0·08	1·89	23·62
Eigheach	818·2	78	0·88	0·21	0·10	11·4	28	6·088	21·7	166	763	16	0·09	63·42	704·66
Rannoch	668·0	808	9·70	1·12	0·76	7·8	440	167·460	38·1	116	306	34,387	7·37	243·57	33·05
Dochart	513·0	67	0·62	0·16	0·11	17·7	11	5·021	45·6	298	652	10	0·07	38·85	555·00
Iubhair	512·0	107	1·35	0·32	0·16	11·9	65	24·960	38·4	110	286	147	0 21	44·61	212·43
Lyon	1050·0	109	1·74	0·26	0·21	12·1	100	44·870	44·9	92	205	461	0·37	10·56	28·54
Earn	317·2	499	6·46	0·80	0·61	9·5	287	137·830	48·0	118	245	14,421	3·91	54·68	13·98
		2743										51,522	15·24	353·42*	23·19

* It must be remembered that the drainage area of Loch Rannoch includes the areas draining into the other lochs given at the head of the table, and that the Loch Iubhair drainage area includes that of Loch Dochart.

This series shows a range of 2°·3 between the temperature at the surface and that at 250 feet, the greatest fall being one of 0°·8 between 100 and 125 feet.

The particulars regarding the different lochs dealt with in this part are collected together in the table on the preceding page, for convenience of reference and comparison.

From this table it will be seen that in the thirteen lochs under consideration, 2743 soundings were taken, and that the aggregate area of the water-surface is about 15¼ square miles, so that the average number of soundings per square mile of surface is 180. The aggregate volume of water contained in the lochs is estimated at about 51,500 millions of cubic feet. The area drained by these lochs is about 353½ square miles, or over 23 times the area of the lochs.

EARTH-MOVEMENTS IN THE BAY OF NAPLES.*

By R. T. GÜNTHER, M.A., F.R.G.S., Fellow of Magdalen College, Oxford.

IV. THE PHLEGRÆAN SHORE-LINE.

(West of Posilipo.)

Evidence of Subsidence derived from the Ancient Harbours.—There was no want of harbours along this part of the Campanian coast at the commencement of our era. Within a few miles of one another were the ports of Cumæ, Misenum, Avernus, Puteoli, Nisida, and Neapolis. Puteoli, owing to its good harbour, became the "emporium maximum," the port at which the great grain-ships from Africa unloaded their cargoes.† The harbour of Misenum is praised as good and deep by Dionysius of Halicarnassus,‡ and as a sheltered haven for ships by Lycophron.§ Nisida harbour had also a good reputation, but safest of all must have been the Julian naval harbour which Agrippa constructed by cutting a canal from the sea through the Lucrine lake into Avernus.‖ To this list we may add the newly discovered harbour of Pausilypon.

At no point did the natural conformation of the shore afford sufficient shelter to ships in all weathers without the added security given by artificial works. The necessary defences were so massive and well built that in nearly every case they have survived to the present day, and their preservation is no doubt partly due to the fact that the land in sinking carried them down to depths at which there is but little erosion. The plan of construction employed by the

---

* Continued from page 149. Map, p. 236.

† Strabo, v. 4. 6.

‡ 'Antiq. Rom.,' edit. Kiessling, i. 53.

§ "παῤ ἄκλυστον σκέπας
ὅρμων Μισηνοῦ στύφλα νάσσονται κλίτη."
'Alexandra,' edit. Kinkel, 735-737.

‖ "Immisso in Lucrinum et Avernum lacum mari."—Suetonius, 'Aug.,' 16.

Romans was the same in all these harbours, and is very different in principle to that employed nowadays. The modern engineer constructs his breakwater of solid continuous masonry so as to completely stop the waves. The old Roman breakwaters were composed of separate piers of masonry or concrete, which rose from firm foundations on the sea-bottom to a few feet above the surface. The piers were strong and broad, and were close enough together to break the main force of the waves, although some wash entered through the narrow spaces. Consequently, in the Roman harbour there could never have been that absolute tranquillity in storm which is the ideal of the modern harbour-designer.

On the other hand, these very openings were of considerable advantage on a coast along which there is a large and unceasing drift of

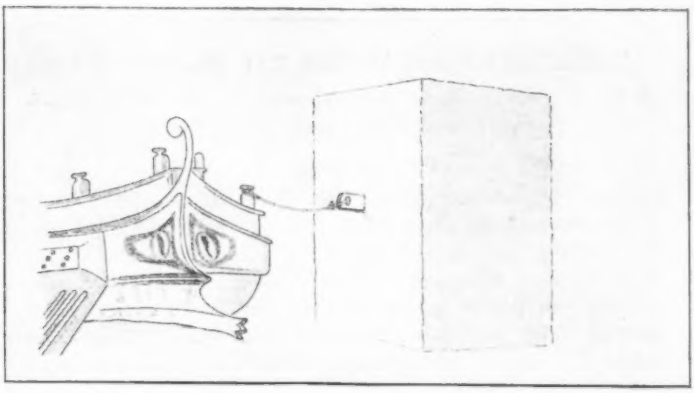


FIG. 12.—ROMAN GALLEY MOORED TO A PILA.
Conjectural reconstruction of pier showing original height of mooring ring.

sand, the effect of the prevalent currents and winds. A marine *cul de sac* unswept by currents soon becomes silted up with mud and sand. The Roman had not the modern resources for dredging at his command, and so it was necessary that his harbours should be constructed in such a manner as not to need them. The success of the Roman plan may be estimated by the fact that harbours which have been in use for nearly two thousand years have only lately been found to need modification.

Harbour of Puteoli.—The largest and best-known Roman breakwater is that at Puteoli, commonly called the Bridge of Caligula. This great work consisted of fifteen tall piers of concrete, some of 52 feet square, others smaller, rising from 49 feet of water to some 16 feet above the surface. The tops of the piers were connected by arches, and the whole work was often referred to as the "opus pilarum," or "moles puteolanæ." Unfortunately, but little of the old work is now to be seen, for the

harbour is sheltered by a solid sea-wall, which has been constructed by filling up the spaces between the ancient piers. The work was

FIG. 13.—THE BREAKWATER OF PUTEOLI.*
(*From a drawing made before* 1768.)

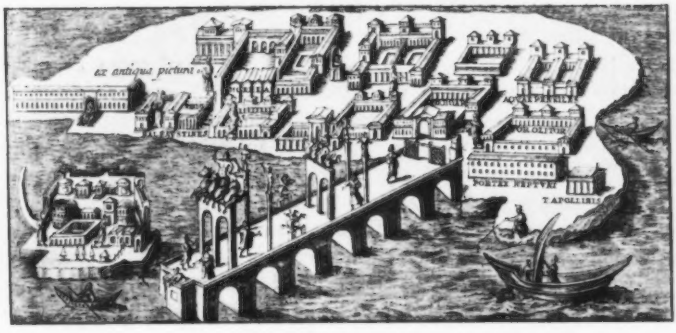


FIG. 14.—THE BREAKWATER OF PUTEOLI.*
(*From a Roman picture, after Bellori.*)

originally proposed by Carlo Fontana, and, in spite of the adverse criticism of Fazio, will soon be finished.

The piers seem to have been used for the purpose of mooring ships,

* The anglers are seated upon the same point, outside the breakwater, in the two pictures.

for most of them were provided with projecting stones perforated for making fast the hawsers. Owing to the general subsidence of the land, these mooring-rings, which must originally have been at a convenient height above the surface of the water, are now from 4 to 6 feet below it. Twelve of these rings have been noted by Fazio. The pier furthest from the shore shows *Lithodomus* borings and the calcareous tubes of *Serpulæ*, to a height of 12 feet above the present level of the sea.

Drawings made of the ruined bridge before it was concealed from view,* show that the springing of the arches was under water (Fig. 13). The Abbé Breislak has pointed out that the piers, when built, must have reached the surface before the springing, and we may therefore argue that they must be at a lower level than formerly. A very satisfactory confirmation of this view is to be obtained from those ancient drawings, which represent the *opus pilarum* in Roman times (Fig. 14). The springing is shown as far from the water as the arch is wide. If we take 35 feet as the average width of an arch, we cannot, after making due allowance for artistic exaggeration, regard 17 feet as an excessive measure of the subsidence which has occurred since the Roman period.

Pausanias' Island.—Within the harbour is depicted a little island covered with buildings (Fig. 14). This island does not exist nowadays, but it is probably that mentioned by Pausanias. "Off Dicæarchia, which belongs to the Etruscans, there is boiling water in the sea, and an island has been constructed artificially, that the water may be utilized for warm baths."† There is a shoal, 13 feet below water, inside the fourth to the eighth piers of the bridge, and the island is represented as lying off the last pier, but only eight piers of the bridge are drawn. Were the other seven of later construction?

The Second Harbour of Puteoli.—There is believed to have been a second or subsidiary harbour at Puteoli, beneath the acropolis. Strabo distinctly refers to the existence of more than one in his time. "This city," he writes,‡ "has become a place of extensive commerce, having artificially constructed harbours, which were much facilitated by the facile nature of the sand, which contains much gypsum, and will cement and consolidate thoroughly. For, mixing the sand with chalk-stones, they construct moles in the sea, thus forming bays along the open coast, in which the largest transport ships may safely ride." And Fazio has described many submerged fragments of building as parts of the harbour defences.

At a distance of 85 to 115 yards from the shore are many piers arranged in two rows parallel to one another and to the shore. A third row of rectangular piers starts at right angles from the shore as

* J. D. Harding's beautiful water-colour of Pozzuoli and of the shore-end of the "Bridge" has been reproduced by the editor of *English Water-Colour* in the Studio Library, under the erroneous title of "An Italian Lake Scene."

† Pausanias, viii. 7, 3. Frazer's translation. ‡ 'Geogr.,' 245.

if to meet the western extremity of the doubled rows. The piers are all 4 to 7 feet below the surface.

Going eastward, we meet with an accumulation of submerged ruins which are not easy to make out, but then follows another basin which is bounded by the shore on the north, the ruins on the west, a single row of piers on the south. The openings between the piers are about 9 feet wide, and there seems to have been a channel for ships between the eastern end of the row of piers and a kind of quay on the east, which is said to be perforated with openings, 4 to 5 feet in width.

Harbour of Nisida.—On the north side of the little island of Nisida, the safety of the anchorage was secured by the construction of two series of piers. The western series consisted of eight and the eastern of seven piers. They have almost all fallen or have become concealed by the modern breakwaters which have been heaped around and over them, but one or two may still be made out. It is fortunate that careful drawings were made when the first modern improvements were being projected in 1814. It was then recorded that not only were some of the piers provided with stone rings for mooring vessels like those upon the Bridge of Caligula, but that even bollard heads were still *in situ* upon them, submerged beneath some 6 to 7 feet of water. Two of the piers of the western series bear two fastenings for ropes, each at the same level. One is a hole cut in a projecting horizontal stone; the other is a bollard head standing in a semicircular niche in the pier (Fig. 15). The upper part of the stone is 11 feet below low-water mark, whereas originally it was probably quite 4 feet above.* So, if we add together 11 + 4 + 2 (the thickness of the stone), we shall get 17 feet as the total amount the land is below the Roman level here.

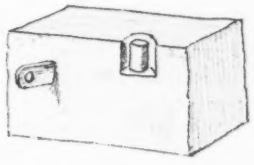


FIG. 15.—MOORING RING AND BOLLARD DISCOVERED 11 FEET UNDER WATER BY FAZIO, IN NISIDA HARBOUR.

Between Nisida and the sandy beach of Bagnoli, the conditions are nearly adapted for the formation of a sand-isthmus, with the result that the island would become a peninsula, like our Isle of Portland. The deposition of sand, however, is prevented by the prevalent westerly current which sweeps through the channel. The tendency is demonstrated both by the silting up of the harbour since the completion of the new continuous moles, and by the sand-shoal in the middle, which may have been a sand-dune connected with the mainland in Roman times.

* Orosius states that the ships of Antony's fleet at Actium (31 B.C.) were 10 feet in height above the water-line. Bollard-heads are shown upon the bows of the ships in a Pompeian fresco (No. 8604, Naples Museum) (cf. Fig. 12), and so 4 feet is not an excessive estimate for the height above water of a bollard or mooring-ring on shore. Such bollards, which were probably known as *tonsillæ*, have escaped the notice of most writers on ancient ships.

Harbour of Misenum.—The harbour of Misenum was provided with two series of piers, designed by the engineers of Agrippa to protect the anchorage from the *scirocco levante*. The piers were disposed alternately, so that waves passing between two piers of the outer series must break against piers of the inner series. There were eight piers in each row, with 3 to 3½ fathoms of water between them. The tops of all these piers are now under water, three coming within 1½, ½, and ¾ fathoms from the surface respectively, but the indefatigable Fazio discovered a horizontal mooring stone fixed in one of the two piers furthest from the shore. The top of this stone was 3 feet below the surface, and therefore has been taken to indicate a subsidence of land-level of 9 feet at least. There are 4 fathoms just off the end pier. Our further investigations were abruptly terminated by a coastguard officer, whose warning was a reminder that Misenum has once more, after a lapse of nearly two thousand years, become a military harbour.

Two Roman tunnels pierce the Pta. di Pennata, and doubtless gave access to an ancient foreshore inside the promontory. Their floors, which we believe to have once been dry, are now 2½ fathoms under water, like the floor of the passage through the Capo Miseno, and the floor of the Greek cave.

The Julian Harbour.—The alterations in the level of the land and the eruption of the Monte Nuovo have so changed the distribution of land and water in the vicinity, that it is by no means easy to reconstruct the exact physical conditions as they existed before the works of the Julian harbour were executed. We imagine Avernus a deep lake as at present, for even allowing the land to be 20 feet lower than in Roman times, the lake would still have been 80 feet deep. On the other hand, the Lucrine lake, although much larger, was probably always shallow. The raised shingle beach separating the waters from the sea probably stood further out, and while maintaining its present height above the water, must have been at a lower level relatively to the land.

The problems which faced the engineers of Agrippa were, firstly, to dig a ship canal from the sea to the safe and deep anchorage in Avernus; and, secondly, to ensure that the entrance to the channel should be practicable in all weathers, and should not be liable to become silted up.

Of their work not many traces are visible, partly because, having been carried down with the land in sinking, it has become submerged in water or sand, partly because it was destroyed or buried by the eruption of the Monte Nuovo, when the greater part of the Lucrine became filled up. So far as can be made out, the actual entrance to the ship canal in the beach of the Lucrine lake was narrow, and difficult of access in rough weather. It was therefore protected by a breakwater of eight piers arranged along a line parallel to the shore, so as to leave a navigable channel which ships might enter from either

end.* The western entrance was still further protected by a row of piers stretching out from the shore at right angles, and ending in a very large and strong pier, the "Lanterna del porto Giulio." Agrippa probably also raised and strengthened the bank between the Lucrine and the sea. The remains of the outer row of piers form the Fumose Reef.† They are arranged in a line south-west to north-east, so that the spaces between the piers are oblique to the southerly winds which blow home here. The harbour therefore consisted of three basins—Avernus, Lucrine, and the outer basin within the eight piers. The work is believed to have been done in 37 B.C., ‡ and it naturally received the highest praise from the court poets.§

However, a few years afterwards the canal seems to have silted up; only vessels of shallow draught could enter, and it became unfit for an anchorage.‖ And so Avernus, like Brundusium, had to be abandoned by Augustus as a station for the Roman fleet. Misenum was substituted for Avernus, and Ravenna for Brundusium.¶

The Harbour of Cumæ.—It is difficult to make out any traces of a harbour, but it is possible that ancient works may lie buried beneath the sands. To judge, however, from the description of Cumæ by Dionysius,** it would appear that the ancient harbour was on the other side of the promontory, and that the ships which took part in the naval battle with the Syracusans had their moorings in the harbour of Misenum.

Lazzaretto di Nisida.—The Bourbon Lazzaretto di Nisida stands on a Roman site of a remarkable nature. The little islet rock (I. di Chioppino, Pioppino, or il Purgatoro), which now forms a strong and natural termination to the eastern mole of the harbour, is traversed from end to end by a slightly curved passage of Roman workmanship, which was lit by apertures in the rock, but these are now submerged. Eight of these windows pierce the eastern and one the western side. In the passage the water is 11 feet deep, although, owing to the accumulation of *débris* near the ends, the floor may be even deeper. At each end is an opening covered by an arch under which the sea ebbs and flows, and which can be entered by boat. The arch over the north end of the passage is rounded, 5 metres wide, and constructed of flat tiles. The south arch is pointed and is constructed of alternating layers of tiles and tufa, the rock above being faced with

* "Mare Tyrrhenum a Lucrino molibus seclusum" (Pliny, 'Nat. Hist.,' xxxvi. 125, edit. Mayhoff).

† Perhaps derived from *saxa famosa* or *famosi*. ‡ Cassiodorus, 'Cron.,' ii.

§ "Or shall I tell of her harbours, of the barriers set upon the Lucrine, and the thunder of the indignant sea where the Julian wave echoes afar in the tideway, and the Tyrrhene surge pours into the channels of Avernus?" Virgil, Georg., II. v. 161–164; also cf. Horace, 'Art. Poet,' 69; D. Cassius, xlviii. 49.

‖ "Εἴσπλουν δέχει πλοίοις ἐλαφροῖς ἐνορμίσασθαι μὲν ἄχρηστος." Strabo, 'Geogr.,' 245.

¶ Brindisi harbour was not rendered serviceable again until dredged by Pigonati in 1776–1778. ** 'Olympiad.,' lxiv.

opus lateritium. We have no means of knowing the purpose of this gallery in the rock, or the manner of fabric of which it once formed a part, but it is evidence that the building stood at least 11 feet higher out of the water than it does at present, and as the sea between this and the mainland is only 10 feet deep, there was in all probability a way across in Roman times. There is also evidence that the tunnel at a subsequent period has been completely submerged, because barnacle-shells have been found adherent to the stones on the roof. This submergence was no doubt coeval with that which resulted in the formation of the groove of erosion on the cliffs at Trentaremi, and at the eastern end of the island of Nisida itself. The same low land-mark has been noted by Babbage on a cliff by the side of the road from Naples to Pozzuoli, where, from perforations in the rock, he extracted fragments of the shells of Lithophagus, Serpula, Arca, and Balanus.

Submerged Ruins near Pozzuoli.—The ancient harbour works have already been described. To the west the shore was lined for a considerable distance by an almost uninterrupted succession of public buildings, and a most convincing demonstration of the rise and fall of land is afforded by some of the ruins. The well-known "Temple of Serapis" or Macellum is described in every geological text-book, and therefore needs no further notice here than the oft-repeated statement that its lowest floor is now 5 feet below the surface of the sea, whereas its three columns "sono un tesoro in geologia, son medaglie coniate dalla natura, le quali non possono essere falsificate" (Pilla). They prove a submergence of about 19 feet below the present sea-level.

Beyond the old Macellum lay the Ripa, a quay with colonnades along which the Puteolans delighted to promenade; and further still, below the Starza, was a Porticus or colonnade, of which there has lasted a long row of columns standing in the sea, which is generally shown as the "Tempio delle Ninfe," and which may have detained "C. Avianium, fortasse in porticu Neptuni ambulantem,"* when he was expected at the villa of Q. Hortensius at Bauli. The ruins may be considered to indicate the ancient shore-line.

It is a matter of interest that certain repairs to the Ripa had to be undertaken in Roman times, perhaps on account of subsidence of the land. The manner of the restoration is recorded in two inscriptions in the Naples Museum.†

Ruins of Bauli.—The beaches of the Lucrine lake and of Baia are separated by a headland, the Pta. dell' Epitaffio, which, jutting out into the sea, forms the northern limit of the Bay of Baia. The modern road from Pozzuoli to Baia rises some yards from the sea to pass through a cutting near the extremity of this headland, and many ruins may be seen on the hillsides. Scotti and Mortorelli support their contention

* Cic., 'Acad.', ii. 25. 80. † Inscr. Neap. 2510 and 2500.

that the ancient Bauli is to be identified with this site rather than with Bacoli on the other side of Baia by much interesting and convincing erudition, and we are fully in agreement with their view that Bauli must have been here near the Via Herculanea, and between the "portus Baiarum" and "Lacus Lucrinus." *

The shore is lined with the ruins of ancient houses, of which the greater part have been washed away.

The most imposing house of all is a three-storey building of which the lower storey is submerged. The scale of the building may be judged by the fact that the chambers are 3½ yards across, and that the vaulting of the ground-floor rooms is 6 feet above the water-level, the floor being about 5 feet below. At the water-level is a course of red tiles perforated with round holes. It is interesting to note that the walls have been eroded at the springing of the arches of the upper storey. We have, therefore, further confirmatory evidence of the greatest submergence having occurred since Roman times, and the well-preserved walls below the erosion-line show that the earth-movements must have been relatively rapid.

In the face of the cliff above the beach may be seen many chambers of another building, of which the front wall has been demolished by the waves.

Were the land-level of the site of Bauli to be raised, the beaches on either side would extend further along under the cliffs, and all the buildings on the shore would be provided with an easy means of access. So it is not at all improbable that in early times the road from Baiæ to Puteoli may have passed round the Pta. dell' Epitaffio, and then along the Via Herculanea close to the edge of the water. And by this highway the first seaside houses at Bauli may have sprung up.

Stagnum Baiarum.—The identification of the Stagnum Baiarum has always been a difficulty with archæologists, and it has generally been considered synonymous with the Lucrine lake. The pool of Baiæ is described in the life of Alexander Severus as if it were a lagoon which was not at first in communication with the sea, but was opened to it, and it is the "STAGNV" depicted upon the Borgiano and Piombino glass vases. "In matrem Mammæam unice pius, . . . ita ut faceret in Baiano palatium cum stagno, quod Mammææ nomine hodieque censetur. Fecit et alia in Baiano, opera magnifica in honorem affinium suorum, et stagna stupenda admisso mari." †

In the Bay of Baia we have a curve in the coast suitable for beach formation, but the water deepens rather more rapidly than off the Lucrine or Fusaro shore; were it shallower, we might expect to find it crossed by a sand-bar thrown up by the sea. If, in accordance with our theory, we imagine the land to be raised 16 feet, the sea would

* 'Nat. Hist.,' edit. Janus, iii. 61. † Lampridius, 'Vit. Alex. Severi,' 26.

retreat from the Bay of Baia, leaving behind an isolated pool of water, 1 to 2 yards deep, a lagoon like the Lucrine lake or the Mare Morto, separated from the sea by a sandbank (Map, p. 236, and Fig. 16).

The proximity of a low foreshore and of such a pool of stagnant water might have contributed to the notorious unhealthiness of Baiæ in certain seasons,* and we believe that we have here discovered the true site of the "stagnum Baiarum." †

Nero's great ship canal would, if completed, have passed through it, and upon the shoals outside we should expect to find the foundations of some of the buildings in the sea of ancient Baiæ.

The Submerged Street between Baia and Misenum.—Some of the maps (Bulifon's map, 1696) of this part of the coast drawn before the

FIG. 16.—BAY OF BAIA.

The dotted line represents the ancient coast-line; the cross marks the site of the Stagnum Baiarum.

beginning of the nineteenth century indicate a street which stretched across the sea-bottom in a southerly direction from Baia towards Bacoli, and which may have been the Via Miseni by the side of which Agrippina was interred.‡

The remains of this street are by no means as numerous or as close together as they appear to have been when these maps were prepared. In the little bay between the Pta. di Cannito and the northern rim of the Bacoli crater the red-brick walls of a house rise from water about 5 feet deep. The bottom is sandy. To the south of this are other walls, and more may be seen under the cliff side of the Cento

* 'Gratulor Baiis nostris, si quidem, ut scribis, salubres repente factæ sunt.' Cicero to Dolabella, fam. ix. 12. 1. Written 45 B.C.

† Not the lacus Baianus, which was probably the Lucrine. Tacitus, Ann. xvi. 4.

‡ Tacitus, Ann. xiv. 9.

Camerelle headland, where there is an ancient structure 5 feet high standing in 8 to 10 feet of water.

Lago Fusaro or Lacus Acherusia.—The western shore of the Phlegræan Fields is chiefly characterized by its shallow lagoons. Between the promontories of Cape Misenum and the Monte di Procida is the Mare Morto, divided from the sea by the Miniscola beach; the Lago Fusaro fills the bay in the hills between Monte di Procida and the hill of Cumæ; north of Cumæ is the Lago di Licola, and still further north is the Lago di Patria. All these lakes are separated from the sea by sandy beaches of relatively narrow width, and their waters stand, in consequence, at sea-level. Any alteration, therefore, in land-level would be followed immediately by an alteration in the level of the water in these lagoons, and a rise of the land of but a few feet would have the effect of drying up the greater portion of them. On the other hand, it must also be borne in mind that subsidence of land tends to cause beaches to be moved further inland by the waves, whereas a rise in land-level would tend to preserve beaches from further alteration by wave-action.

The waters of the Lake of Fusaro communicate with those of the sea by a canal which enters a Roman tunnel * under the tufa hill of Torre Gaveta. The tunnel is 196 yards long, 14 to 18 feet wide, and of the same height as the Posilipo tunnel. The depth of water in it is about 4 feet, and a masonry lining of *opus reticulatum* and *lateritium* covered the interior. This tunnel is commonly believed to have been made for the purpose of an emissary to the lake; indeed, Fazio has argued from it that the sea-level in Roman times must have been the same as at present.

On the hill above the tunnel are the ruins of the villa of Servilius Vatia,† and in the sea below are many submerged ruins, the most important of which are described by Niccolini as the Bagno dell' Arco, a chamber hollowed out of a detached rock, with five niches on either side; an ancient cistern; a "bath" with three large niches, also cut in the rock; and a flight of steps. A re-examination of this site has convinced us that here too there is evidence of considerable subsidence. In fact, we believe that the niches and floors of the so-called "baths" were originally above water, and that two of the rock-hewn cavities were the caves which Seneca considered worthy of mention.

The floor of the tunnel through the rock must also have been dry, and therefore it appears that the hill was pierced to permit of access from the land to the buildings which stood clustered at the foot of the hill on the sea. If there had been need of any artificial communication between the Acherusian lake and the sea, it is more likely to have

* Sometimes called a cave of Cerberus.

† There is no other site which answers so well to Seneca's description: "Speluncæ sunt duæ magni operis, cuivis laxo atrio pares, manu factæ, quarum altera solem non recipit, altera usque in occidentem tenet." Seneca, Epist. lv.

been cut through the low and narrow beach of the lagoon than through a hill of solid tufa.

The enumeration of submerged constructions might be much prolonged, but to no very useful purpose, and so we will bring our list to an end by mentioning the Great Cave * of Greek origin under Misenum, the floor of which is now at least 6 feet under water; also the rock-hewn chambers * near the Grotta Dragonara, the lowest of which is flooded to a depth of about 13 feet; and, finally, we regretfully have to admit that the "Styx" could never have existed in classical times in its present situation, for the floor of the "Cave of the Sibyl" would have been high above the drainage level.

V. GAETA.

That the effects of the oscillations of the land have been far-reaching is demonstrated by the observations of Niccolini at Gaeta, and we have been informed that similar phenomena are to be seen at Monte Circello. In the little bay of la Conca, the main road from Rome passes close to the sea, but some 20 yards above it. Here the clear water from a spring has been collected into an ancient bath hollowed out of the limestone, and from thence it flows by two channels into the sea.

On either side of the entrance to the cavern of the Conca, the older portions of the face of the cliff show an upper erosion-line at a height of 19½ feet above the present sea-level. To the east of the cavern, at a height of 16 feet, a surface of *opus reticulatum* bears those unmistakable imprints of having been below water, the remains of shells still adherent to the mortar between the stones, and the minute perforations due to marine organisms.

Below the water near by are the ruined foundations of a building of some complexity, which are submerged to a depth sufficient to allow boats to pass over them.

Period and Duration of Earth-movements.

Were these changes of level continuous or spasmodic? When did they take place? How long were they in operation?

As regards the question of their continuance, we see them represented by Niccolini by a curve indicating that in his opinion they were continuous. Our own observations, showing that the erosion has been principally restricted to definite zones, lead us to disagree with this view. There is evidence that the levels of sea and land have remained relatively constant for long periods of time, and have then altered with comparative rapidity. An alteration of level averaging 3 inches per annum would, in our opinion, be a rapid change. A movement of subsidence averaging four-fifths of an inch has been recorded in quite recent years.

* An illustrated description of these artificial caves, as well as of the Lazzaretto di Nisida and of the houses at Baulì, is in the Press for early publication in *Archæologia*.

Unfortunately, the evidence that is forthcoming to aid us in elucidating the two latter points, the period and the duration of these changes, is not very exact; but what there is of it has been summed up by Prof. Suess.

There is an undercliff near Pozzuoli, called "La Starza," which was under water from the thirteenth to the beginning of the sixteenth century; this is now high and dry. The date of the rising is supplied by documentary evidence, for Ferdinand the Catholic in 1503 made a gift to the University of Pozzuoli of land "where the sea was drying up." It follows that the land must have begun to rise at an earlier date. In 1538—that is, thirty-five years after—occurred the "horrible and astonishing eruption" of Monte Nuovo, and a great piece of the sea-bottom is stated to have been left dry. According to Prof. Suess,* it was at this time that the rise of the Temple of Serapis, and therefore of the land around the New Mountain, took place; that is, that there was a rise of some 18 to 19 feet in a few hours. While fully allowing a small local rise of land of a seismic nature during the eruption, the evidence does not justify us in assuming the great cataclysm the acceptance of Prof. Suess' theory involves. We have shown that the facts point to the movement of the Temple of Serapis having been accompanied by the movement of Posilipo, of the Sorrentine peninsula, of Capri, and of Gaeta, and therefore probably of a far larger area than the Bay of Naples. And with documentary evidence to the contrary, it is surely not right to assume that so large a portion of the Earth's surface should have suddenly become possessed of sufficient mobility to have sprung up 18 feet in a few hours. And, even had the area been more limited, and restricted to the Bay of Naples, it is still unlikely that a movement so sudden would have remained unchronicled in the time of the gifted viceroy Pietro di Toledo, all the more that he was just then engaged in the erection of a new lighthouse upon a mole in the port of Naples.

That earth-movements of almost seismic rapidity have often occurred is certain; for instance, on December 8, 1861, Palmieri recorded an oscillatory movement of the shore accompanying an eruption of Vesuvius. Rocks covered with seaweed and shells were raised 1·12 metre above the sea-level at Torre del Greco, and during the next three months sank 0·241 metre. But this movement was very local, being almost entirely restricted to the base of the mountain.

It appears, then, that the last great upheaval of the Italian coast, whatever the cause, was on too vast a scale to have occurred during the short-lived convulsion of Monte Nuovo. We believe that the land had been rising steadily, though the movement was unfelt, during the half-century preceding the formation of Monte Nuovo; that this

* 'Antlitz der Erde,' vol. ii. p. 490.

earth-movement was attended by conditions favourable to the production of volcanic phenomena; that an eruption and a sudden local rise took place towards the termination of the whole movement;—in fact, that the eruption of Monte Nuovo was but an insignificant episode of only local importance in the closing scene of a particular phase of an oscillation of the Italian coast.

Subsidence of Land in Recent Time.—As evidence for the nature of the land-movements which have been taking place in the most recent times, we have the general belief among boatmen and fishermen that the land is lower than it used to be in their fathers' day. We have heard it stated that it was possible to walk dryshod along the Posilipo

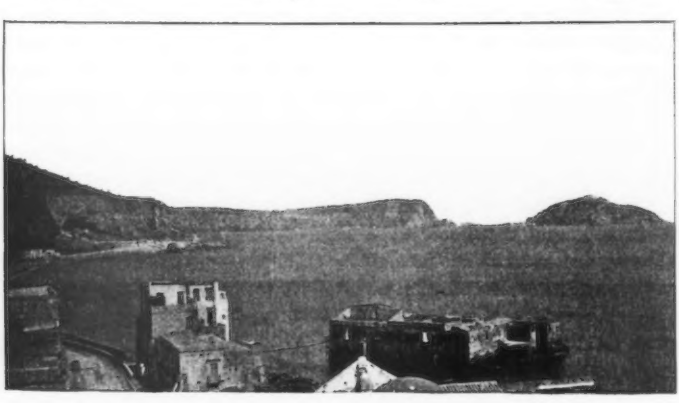


FIG. 17.—OSPIZIO DEI CAPPUCCINI, POZZUOLI.
(From a photograph by Brogi.)

shore from the Villa Grotta Marina to Palazzo Donn'Anna in 1820; now it is impossible. Colonel Macintosh has made a similar observation with regard to the Pozzuoli shore. He was informed that in 1847 monks inhabited the Ospizio dei Capuccini during the warmer months of the year, in spite of the fact that the water stood so high as frequently to enter the lower storey of the building, covering the floor. The refectory, kitchens, etc., had therefore to be entirely abandoned, and the monks resided altogether in the upper storey, and had done so for some time. The side of the convent next the sea (under water in 1847) had been a vineyard, and an old monk (about sixty) stated that he had for many years eaten grapes grown on a spot which he pointed out, and which Macintosh saw covered with about 3 feet of water, and traversed by boats. Vestiges of the walls of the vineyard were to be seen standing in the water.

All that remains of the hospice at present is literally in the water, and the wooden bridge out to it passes over the remains of a pavement which, though now more than a foot under water, was used a few years ago by persons entering the convent.

At various times the roadway between Pozzuoli and Naples has been undermined by the sea for a considerable length, although very strongly built and faced with solid masonry. The damage was attributed solely to stormy weather; but a sinking foundation was most likely an assisting cause. The new road has been constructed further inland at immense cost by cutting into the face of the old lava rocks, where they advance close to the sea, and forming breakwaters at other places of enormous blocks of that stone.

We may perhaps be permitted to repeat here the hydrometrical observations of Niccolini, made with a tide-gauge fixed in the Temple of Serapis, which was then in more open communication with the sea than it is at present. From October 6, 1822, to July 1, 1838, the land sank 4·3 inches, or from about 0·27 to 0·31 inch per annum; and from July 1, 1838, to July 1, 1845, it sank 5·6 inches, or at a rate of about 0·8 inch a year. Scacchi notes that in 1852 the water was not standing as high as in 1845, so that the land appeared to be rising once more (Roth). The observation may, however, have been due to the prevalence of a particular wind, which, as we have often observed, may produce a difference of water-level of a few inches. Guiscardi has noted a subsidence of the Bridge of Caligula of 0·349 metre in twenty-five years.

On account of fluctuations of sea-level due to wind and tide, it is not always a simple matter to make accurate observations of land-level, and records depending upon a single observation are liable to considerable error. In order to ascertain the mean tide-level, observations of the height of the sea were made during the summer of 1901, with a tide-gauge fixed to the quay of Villa Rosebery: we noticed a variation of as much as 16 inches in a few hours during spring tides. These observations ought to be repeated in a few years' time, in order to ascertain whether the subsidence is still continuing.

It is worth noting that Neapolitan engineers undertake a great work like the *emissario di Cuma*, a sewer 9½ miles long, and with a fall of only 0·65 in 1000, across a region which has been so subject to changes of level. Water has long ceased to flow along the ancient Roman aqueducts to Puteoli and Misenum: may not the earlier earth-movements have been the cause?

General Conclusions.

That the upward movements of the land in recent geological times have been much in excess of the downward movements, is shown by the occurrence of recent marine deposits on Mount Epomeo in Ischia,

at a height of 500 metres above sea-level. When these deposits were in process of formation, the whole of the Phlegræan fields would have been submerged. The land did not rise continuously, but remained stationary at the levels now indicated by the sea-worn caves high up on the cliffs of Capri and of the mainland. The Lithodomus borings observed in the Tiber valley at heights of 276 and 268 metres (Suess) were probably formed about the same time. During this period of elevation, the sea-bottom was rent by the volcanic outbursts, which threw up the older craters of the Phlegræan Fields, and the sea carried the ashes far up into the valleys of the Apennines.

Later stages in the elevation are indicated by the deposits of sea-sand older than the Roman period upon Monte Olibano, at a height of 32 feet.* The upward movement continued until the land reached and passed its present level by some 20 feet at least. So far as our evidence goes within the historical period, the land stood at its greatest elevation at the time of the Greek colonization. That a slight subsidence may have been going on during the Roman dominion is indicated by the repeated incursions of the sea across the ancient Via Herculanea into the Lucrine lake and by the need of repairs to the Ripa, but that the land was still at a much higher level than it is now is certain. The fall of the land followed the fall of the empire.

In the dark ages the larger part of Amalfi was carried down by the subsidence and lost under a waste of waters. The upper groove of erosion was being etched upon cliffs and buildings in the thirteenth, fourteenth, and fifteenth centuries. The most recent elevation of the land occurred about the beginning of the sixteenth century, but was not great enough to lay dry the Roman foreshore, which is now for a second time slowly sinking beneath the waves.

Several facts, hitherto unexplained, are in accordance with the theory of subsidence. There is evidence that the banks of the Tiber are much lower at present than in ancient times, whereas the water in the river, depending as it does upon the level of the sea, has remained at its original level,† for Pliny (xxxvi. 104) speaks of Agrippa being rowed into the Cloaca maxima, the mouth of which it is now impossible to enter.

Further, a Roman mansion was discovered in the gardens of La Farnesina, which was decorated with magnificent paintings and stucco panels. The pavements of this noble mansion were only 8·20 metres above the level of the sea, and about 3 metres above the level of the Tiber. During the four months employed by Prof. Lanciani in removing

* Babbage and Sir Edw. Head in 1828; 12 metres (Suess).

† Measurements made at the marble wharf (*Marmorata*) and alongside the ancient embankments show that since the fall of the empire, the modern bed of the river has hardly risen 3 feet with reference to its banks (Observations of Padre Secchi in 1869 and of the engineers, reported by Prof. Lanciani).

the frescoes and panels, the Tiber entered the house five times. By the theory that the land is lower than when the house was built, these facts are explained.

And by the same theory we may explain the apparent rise of the subterranean water-level under Rome. On either side of the Via Poli the pavement of an ancient street was found under 2 feet of water; the cellars of the wine dock in the gardens of La Farnesina were flooded up to the key of their vaults in 1877, and many other instances are well known to the explorers of subterranean Rome.

On the other hand, the advance of the coast westwards at the mouths of the Tiber, at a rate which has been estimated at 9·20 metres per annum at the Ostia mouth, and 3·10 metres at the Fiumicino mouth, would at first sight seem to be in opposition to our theory of subsidence, were it not for the fact that the river brings down some 4,000,000 cubic metres of sand and mud per annum, and that the prevalent winds are from the south-west.

To return to the Phlegræan Fields, our theory explains why the Lago d'Agnano, a large sheet of water a mile in circumference in the seventeenth century, is not mentioned by any Roman writer, for with the land at a higher level, the drainage level of the country would be relatively lowered, and the Lago d'Agnano would not have been in existence.

And, finally, we wish to attribute to the same cause of subsidence the present unhealthiness of the low-lying plain of Paestum. We do not believe that a city containing some of the most magnificent Greek temples, and one which had reached the state of culture implied by the frescoes in the Naples Museum, would have flourished in the middle of a malarious swamp, the nursery of mosquitoes, and now abandoned to snipe and buffalo.

Note on an Unrecorded Submarine Sulphurous Spring.

When bathing in calm weather inside the modern breakwater near the Capo di Posilipo, we noticed, on several occasions, the odour of sulphuretted hydrogen very distinctly at a particular spot near the middle of the harbour. The existence at this spot of a mineral spring of the nature of the *acqua solfurea* of Santa Lucia in Naples has, so far as we know, not been placed on record, although in a cave near by sulphuretted water has been pumped for many years. The source of the spring would have been above the sea-level in the Roman days, and would have been near the line of the ancient coast road. The exact position will be indicated in the map to our archæological paper.

REFERENCES.

Babbage, C.—'Observations on the Temple of Serapis.' 1847.

Bellori, J. P.—'Fragmenta vestigii veteris Romæ.'

Beloch, J.—'Campanien.' 2nd Edit. 1890.

Brauns, —.—'Das Problem des Serapeums von Pozzuoli.' Schriften der Leopoldinischen Akademie. 1888. [The author considers the Serapeum to have been an aquarium for marine fish!]

Breislak, S.—'Voyages physiques et lithologiques dans la Campanie.' Paris. 1801.

Cluverius, P.—"Italia antiqua." Lugd. Bat. 1624.

Fazio, G.—'Discorso intorno al sistema di costruzione de Porti.' Napoli. 1814.

" 'Nuove osservazioni.' Napoli. 1832.

Goethe, W. von.—'Architectonisch-naturhistorisches Problem.' 1823.

Günther, R. T.—"The Phlegræan Fields." *Geogr. Journ.*, October, 1897.

" "On the Possibility of obtaining more reliable Measurements of the Changes of the Land-level of the Phlegræan Fields." *Scottish Geogr. Journal*, October, 1900.

Kopisch, A.—"Entdeckung der blauen Grotte auf der Insel Capri." *Reclam. Univ. Bibliothek, No.* 2907.

Lyell, C.—'Principles of Geology.' London. 10th Edit. 1868.

Macintosh, Colonel.—"On the Ospizio dei Capuccini at Pozzuoli." *Quart. Journ. Geol. Soc.*, vol. iv., 1847.

Mackowan, Captain.—'Capri.'

Mangoni, R.—'Ricerche topografiche ed archeologiche sull' isola di Capri.' Napoli. 1834.

Niccolini, A.—'Descrizione della gran terma puteolana volgarmente detta Tempio di Serapide.' Napoli. 1846.

Paoli, Padre.—'Antiquitatum Puteolis, Cumis, Baiis existentium reliquiæ.' Napoli. 1768.

Roth, J.—'Der Vesuv und Umgebung von Neapel.' Berlin. 1857.

Suess, E.—'Das Antlitz der Erde.' Vol. ii. 1888.

Erratum.—P. 127, footnote: *For* St. Michele and St. Croce *read* S. Michele and Sta. Croce.

Before the reading of the paper, the PRESIDENT said: Our associate, Mr. Günther, was the last of our travelling students at Oxford, and when he was appointed he selected, as the region that he would examine, the country round the Bay of Naples. Since then he has continued his researches, and I think you will find from his paper that he has done some very excellent work. I will ask Mr. Günther to read his paper.

After the reading of the paper, the following discussion took place:—

Mr. J. J. H. TEALL: I think, sir, we must all agree that we have listened to a very important paper on a very interesting subject. It evidently contains a large amount of carefully observed facts, and it is coupled with a good deal of classical research. Indeed, what strikes me as one of the leading features of the paper is the way in which the author has brought all kinds of knowledge to bear on this problem, and has led up to some most interesting conclusions. I regret, sir, that I have no personal acquaintance with the district, and the very few remarks that I can offer must be based on second-hand knowledge. The last general discussion of the phenomena of the rise and fall of land on this portion of the Italian coast, with which I am acquainted, is that contained in Prof. Suess' well-known work. He refers to the three columns of the Temple of Serapis, and arrives at the conclusion that the oscillations, recorded by those columns, have taken place in the interior of what he calls the Phlegræan crater, and are comparable to the rise and fall of the lava-crust in the crater of Kilauea, or to the rise and fall of the ice-covering of a pond in consequence of the change in the amount of water in that pond. In short, he arrives at the conclusion that the phenomena are strictly local. Now, the paper that we have listened to seems to show very clearly that the phenomena are far more general than

would follow from Prof. Suess' view; that we have not simply to do with the oscillations of land in a crater, but that we have to do with phenomena in post-Roman times which have affected a very considerable extent of coast. Indeed, I gather that Mr. Günther would connect the movements that he has described with those that have taken place as far north as Rome. I can imagine that there may be some doubt as to whether the coast along the whole line moved simultaneously; but certainly the evidence, as he has presented it, seems very strongly to point to that conclusion, and if so, then we have to deal with phenomena far more general than those contemplated by Suess, and we are led on to consider whether the movements along the Neapolitan coast are not movements analogous to those in Scandinavia and many other districts. Mr. Günther is strongly of opinion that these changes of level are to be attributed to changes in the level of the land, and not in any way to changes in the level of the water. He has proved quite clearly that changes in the level of the water will certainly not account for all the phenomena. The tilting of the upper erosion-line in the island of Capri proves, of course, in the most convincing way, that some movement of the land must have taken place. I can imagine, however, that Prof. Suess would claim, at any rate, a portion of the phenomena as being due to changes in the level of the sea, and on that point I certainly do not feel competent to express any definite opinion. Well, sir, the paper, as I said, is undoubtedly a most interesting contribution to a most important subject. We shall all study it, I am sure, with the very greatest of interest, and all future discussions, as to movements in relative level of land and sea, will have to take this communication into consideration.

Prof. Bonney: My friend Mr. Teall has seized upon the salient point in this paper; it is that Mr. Günther has made perfectly clear what was a matter of doubt before. We all have known for long—at least 150 years—that there had been a depression and then a rise of the land in the immediate neighbourhood of Pozzuoli, but neither Lyell nor Reclus would venture to say positively that that was more than a local change, and there was a disposition to connect the subsidences and the rise with an eruption in the year 1538. Now, it seems to me that Mr. Günther has brought together such a mass of evidence of different kinds that he has proved this phenomenon to be not a local phenomenon, but one which affected very large areas of that part of Italy, so that, as Mr. Teall says, this paper takes us forward a distinct step. The movements up and down in the Bay of Naples take their place with other movements in other parts of the Earth's surface. One point in Mr. Günther's paper was distinctly news to me. I had always supposed it possible the coast might have been a little higher in Roman times, but I never realized that the evidence was so strong as it is that the land must have stood at least 17 feet higher in Roman times, and then have sunk to something like 18 or 20 feet below its present level, and afterwards, probably in the earlier part of the sixteenth century, have come up. In fact, we can fix the dates tolerably well. The so-called temple could hardly have begun to sink before the earlier part of the fifth century, and between that date and the earlier part of the sixteenth century the submergence, the boring into the columns, and the rising again must have taken place. This is a part of a very much wider-spread phenomenon. It has been asserted that since the first advent of our forefathers into the district of the lowlands of Europe there have been rather marked changes of level, and some even think that the coast of Holland, the coast of the north of France, and even the coast of steady-going Scotland, have not altogether preserved their level. It has been claimed that in the Firth of Forth there has been a slight change of level since the Roman times. It would be a very good thing if we could have a series of marks run across England from sea to sea; not

that we should get the benefit of them, because for any one to do it for his own satisfaction would be something like that celebrated Greek who, when he was a very old man, having been told that a raven lived a hundred years, bought a young one for the purpose of making the experiment. The movements will be slow, but still we want some more definite evidence to see whether the level of the land remains as uniform as is supposed. There have been changes in South America and New Zealand, sometimes slow and sometimes quick; but in many parts of the Earth there are earth-movements which cannot be explained by mere changes of sea-level; in some cases they must certainly be changes of land-level. I think Mr. Günther has made it clear that, although the change in the level of the sea has had something to do with it, here in the Bay of Naples there has been also a change in the level of the land, and one that has affected a very large area.

Dr. H. Woodward: I do not think I can add anything to the remarks Mr. Teall and Prof. Bonney have already made on this very admirable paper. It is most interesting to find that a subject which was taken up by Mr. Babbage in 1828 has now been made use of as the text for a new paper to-night, and that around the Temple of Serapis, which was the original subject on which Mr. Babbage founded his paper, Mr. Günther has gathered a vast number of valuable and new facts which all bear upon the same problem. The importance of the Mediterranean seaboard for examinations of this kind is very apparent, because the effect of the tides on the coast is there less visible than on our own shores, for instance, where a great rise and fall take place, especially on the western side of England. But in the Mediterranean, where only a few feet constitute the mean between high and low water mark, these lines of old erosion, which stand at a height of 20 feet or more above the present sea-level, and are exact replicæ of the marks which the sea is now producing on the sea-level, are of the greatest value to the geologist as evidence of an ancient sea-margin, and furnish an admirable record of the former height of the coast-line. On our own coast, we have not those records which mark the Bay of Naples in the shape of historical buildings which can be made use of, but we have many indications; for instance, in the submersion and erosion of the Channel islands and of the western coast of the Bristol channel, and many submerged forests along the coast which indicate in pre-historic times great changes of level along our shores. But the advantage of the spot which Mr. Günther has selected lies in the fact of so many important date-marks being found on the coast which fix the exact time and period in history during which the change of level has arisen. Of course, we have another factor in the Bay of Naples which is not to be appealed to on our own coast, that of the near presence of active volcanic movements and disturbances, so that that factor has to be taken into consideration in the changes which have been indicated in the paper that we have listened to to-night. Still, the importance to the geologist and to the antiquarian in the work which Mr. Günther has done cannot be overestimated, and some of the things which he has mentioned in his paper—all of which I do not think he read—with regard to the interior of those grottoes are of very great importance, because he takes the line of argument that those caves have not been eroded by water-action such as we are familiar with in the caves of Derbyshire and other limestone caves in this country, where fresh water has acted upon the rocks and has eroded the caves before they came within reach of the sea. In this case, Mr. Günther argues that the change of level of the sea has eroded the caves; that when the sea was at a high level it eroded the roofs of the caves, and when at a lower level it eroded the floor; and he has cited evidence of very great importance that in the Blue grotto there was formerly an entrance to one of the palaces above, which was actually accessible then, not as now by small boats, but by ordinary

vessels, which could have reached the entrance of one of the old Roman palaces that stand on Capri above the cave. I am only recapitulating remarks which will be found in Mr. Günther's paper, and therefore I must apologize for detaining the meeting by further remarks; but I have been extremely interested both from a geological and a geographical point of view in the paper which Mr. Günther has read, and I congratulate the Society on having received so valuable a contribution.

Mr. D. G. Hogarth: I do not think, sir, that I can do very much more than congratulate Mr. Günther upon the success of his archæological evidence. This is not perhaps primarily an archæological question at all, and as an archæologist, when one has to deal with subsidences of the land, I am bound to say I have always feared the verdict of the geologist. On the present occasion, I think Mr. Günther has had emphatic confirmation from most distinguished geologists. Some part of Mr. Günther's evidence, particularly that part referring to plans of houses taken by the sea-telescope, would not, had it stood by itself, been convincing. It is always extremely difficult so to distinguish the ground-plan of the habitable part of a house from a ground-plan of foundations. When you cannot make out the walls, and still less clearly the doors, it is almost impossible to produce conclusive evidence that what you have been surveying is really a ground floor. I should say, having seen Mr. Günther's surveys, that he did find parts of houses once inhabited; but there are other facts which Mr. Günther did not dwell upon which were absolutely conclusive. There are flights of steps which are now a considerable depth below the water. You do not build flights of steps so that the top step is 6 feet below the surface. There was one point which he did emphasize, and that was the piers which have holes now several feet under water, and rings to which ships were once moored. Again I put it to the meeting, for what purpose could these rings have been put in their present position except for mooring vessels. These phenomena are to be found on a very large and interesting scale in Alexandria, where at present, as I found to my cost, not only has the water-level risen on the land to such an extent that all early Alexandria is now under water at the spring of the year, but there extends out into the sea, in what is not now the harbour, but was the old harbour, very large remains of buildings which are now entirely a-wash. It was there I tried to make a little experiment in submarine surveying. I only wish some one who had the patience and experience of Mr. Günther would go to Alexandria and examine the coast. There may be found, by the use of the submarine telescope, not only interesting ground-plans, but also interesting and artistic remains. I am thankful that he has brought to bear such a mass of evidence as to leave no doubt about the subsidences.

The President: I am sure the meeting has listened with great interest to Mr. Günther's paper, and I think we ought to congratulate him on his views having received confirmation from the eminent geologists who have honoured us with their presence this evening. As I listened to the paper, I could not help reflecting of what great value history, and especially archæology, often is in the solution of geological and geographical questions; and, further, I reflected on the importance of extending our knowledge of these phenomena of the subsidence and rise of the land in other parts of the world. I do not know whether Mr. Günther intends to continue these investigations elsewhere (at least in the Mediterranean I hope he does), but I do think that the collection of all evidence connected with this subject in other parts of the world—and I know that there is a large amount of evidence—would be most useful work. I hope that some of our young geographers will devote themselves to research of that kind. I am sure the meeting will wish me to convey to Mr. Günther a unanimous vote of thanks for the admirable and very interesting paper he has read to us this evening.

ON SPHERICAL MAPS AND RELIEFS.*

By Prof. ELISÉE RECLUS.

I AM very sorry to be obliged to speak in English, because it is a long time since I have had an opportunity of airing it, and so I am afraid that, having only crossed last night, I have not yet taken sufficiently to the English language to be perfectly well understood by you. But I will try to explain my models, and if I cannot explain them in English, then my French will come to the rescue.

I intend to speak on geographical education. I think we are all agreed that it is only by observation that we can really understand nature. And what comes out of nature? The comprehension of the surroundings of man, and afterwards the comprehension of man himself. It is not first by the use of globes or of maps or of any artificial means that we are to teach children, and not only children, but all other people; it is by the observation of nature. It is by working especially in nature; and if you work in nature you have two good things—first, health, and then science. And it is in this way that man commenced to learn. He did not know at first that the Earth was round, and it is only three thousand years since people commenced making maps. Not long ago a great scientist, a geologist and botanist, told me how thankful he was to his mother for teaching him to observe nature. "My mother," said he, "was very poor in science, but still she observed, and she made me look with wonder at the little rivulets in the gutters; she showed me also the little glaciers on the roofs of the houses, and it is thus that I learned some very important phenomena of rivers and of glaciers." Well, it is in the same way that we are to learn, and it is the way that will make the most lasting impression, because, as I have already said, your scientific knowledge is not acquired by artificial means, but by observation of facts. The time, however, comes when you are obliged to use maps, but at the outset I think maps ought to be entirely tabooed. They must be tabooed, because maps are made on different scales, and that being so, it is quite impossible to compare them; and if you cannot compare them, it is only waste of time and trouble. I do not believe there is a geographer in the world—I do not know of one—who is quite conversant with the different scales of the various maps. We who have a certain reputation as geographers have just the same trouble as other people, because when we study distant countries on various maps—take, for example, Java and the Netherlands—the maps of Java are always small and the maps of the Netherlands are large, and therefore it causes a great confusion in one's mind. Therefore, in all well-conducted schools, globes should be used, and children ought to be entirely forbidden the use of maps. It is by the

* Read at the Royal Geographical Society, April 2, 1903.

reproduction of nature that we learn; and as the child will learn sooner or later that the Earth is round, then you should show him something that is round as the Earth is. I think, in England generally, if you speak of the "use of the globes," it seems to call to mind the period of the Renaissance, when people used globes for the teaching of geography much more than we do now. In pictures of the sixteenth and seventeenth centuries, for example, when a learned man is portrayed, you generally find he has a globe near him. Now this use of the globe is much less general than it was at that time, and maps and atlases have taken its place. Globes were usually from 1 foot to 1½ foot, and sometimes 2 feet in diameter. Of course the scale was not accurate, because people did not know exactly what was the roundness of the Earth. The scale was generally 1 : 25,000,000, or from 1 : 30,000,000 to 1 : 40,000,000. But now we think that, as the circumference of the Earth has been pretty accurately calculated, it is convenient to have globes with a fixed scale, about the same size as that which was used generally by all the learned men of previous centuries, because they were easy to manage. Well, this one is 1 metre in circumference, with a scale of 1 : 40,000,000. If you want larger proportions, then you can have the proportion of 1 : 20,000,000, and then the globe will be 2 metres in circumference. If the globe is 4 metres in circumference, the scale will be 1 : 10,000,000, but globes of 4 metres in circumference are too cumbersome, and you are obliged to suspend them from the ceiling, and so they are perhaps a little difficult to manage in a school. Therefore it is absolutely necessary to adopt some other method, but always keeping the idea of the globe in mind, because you must always keep to truth. When you make things illusory—well, at the same time you make them treacherous. When people do not quite understand, but imagine they do, then their judgment is not reliable. And so if you want to represent something which is round, you must do so with something which is round. To show a globe of huge dimensions is impracticable, but you may at least show a slice of the Earth, a slice of the superficial part of the Earth, and the effect is the same. And so, for example, if you want to make a globe in the proportion of 1 : 5,000,000, it would have to be 8 metres in circumference, dimensions which are too large for an ordinary room. If, however, you cannot have the whole globe, you can have slices of it, and then you can see places as they are. And in this way you can make the child understand. The world is round, and he sees it round as it is. And if you want to show the globe entirely, this being in the proportion of 1 : 5,000,000, you have nearly 150 of those slices to complete the whole globe; but most of the Earth being covered with water, about 50 of those slices would represent all the continents of the world, while the remaining 100, representing the water, would be less useful. But you must keep this in mind, that as your slices of the globe are only in the proportion of 1 : 5,000,000, it is absolutely

impossible to show the relief otherwise than by colours or shades; true relief begins to be visible by slight asperities only when the proportion is from 1 : 1,000,000. If you teach geography after this method of globular slices, you can be quite sure that there will be no hindrance to the intelligence of the child. He will perfectly follow all your reasonings and understand everything, because he sees the roundness of the Earth.

Now let me pass to another subject. There is in Germany a certain divergence of opinion among teachers of geography about what they call "Einheit-Atlassen." I understand that this word applies to the same model being put in the hands of all pupils. But I thought to myself, when I first heard of them, that these atlases contained maps all constructed according to unity of scale, which would be indeed a splendid achievement. Proctor produced such an atlas about fifty years ago, but without great success; people were not yet prepared to the grand idea. In maps which do not accord with the principles of unity, but are made according to thirty or forty different scales, it is quite impossible to compare satisfactorily the various coasts, countries, and parts of the world. Proctor's atlas is comparatively a very small book, but it is a treasure, and I think it ought to be considered as one of the most important contributions to the teaching of geography that has been made. It was an excellent idea, and it will always have its admirers, but it has not made the way in education it ought to have. I think it is absolutely necessary to renew his idea, and we ought to have what I may call an isometric atlas—that is, an atlas in which all the maps are drawn to the same scale. With maps drawn to different scales, you never can say, "Well, I know that the proportion here is ten times larger, and therefore, of course, it is ten times larger in longitude, and also ten times larger in latitude, and so altogether this map is a hundred times larger than the other." If you have one map drawn to a scale of 1 : 30,000, and another 1 : 50,000, and another 1 : 70,000, and another 1 : 350,000, it is impossible to get out of the tangle—quite impossible, and so I say the education of children is quite biased.

Well, if we are of the same opinion on this subject, let us go further to an important question, that of the "typical" reliefs. For example, I would reproduce Mont Blanc in relief with the proportion of 1 : 100,000. Then the mountains would be about 4 centimetres above the plains. Of course the height would not be increased more than the breadth or length of the country; it would exactly conform to truth itself. This is a point I have contested with many relief makers. I think they are wrong when they show a relief which is not true in proportion. It is absolutely necessary to have an idea of geological shape; it is therefore necessary to know the slope; but if you heighten the slope twice, thrice, four times, or ten times, it is impossible for you to imagine the reality—the thing is made false in your mind, and so no reasoning can be connected

on the true shape of the country represented. If you want to show the truth, you must give the proportions exactly as they are in nature. If you want to represent Mont Blanc, in the proportion of 1:100,000, you will see exactly the shape of the mountain and the valleys which surround it, and also the proportion of one part to another. The same observations might be made with regard to any other mountain. You might construct a model of the Jura, or the mountains of Wales and Scotland, or you might construct a model of Gibraltar or the Cape of Good Hope, all true to nature. But there is a very great difficulty with regard to ordinary reliefs, because they are cumbersome and difficult to construct; they have to be modelled, and, being made in plaster, require careful handling. It would, therefore, be much better if you could make them of some other material, and if, instead of moulding them, which is difficult, and renders the thing exceedingly costly, you could stamp them out of sheets of metal like this (referring to model). For two or three years a very skilful draughtsman, Mr. Patteson, the son of an English artisan, who went over to Belgium, has been doing this. He is a good craftsman, a good mechanic, and also a mathematician, and when he had worked at the problem for some time, he found out a method of producing the printed relief as it is wanted. This particular relief (referring to model) represents one of the most precipitous parts of Belgium. We might have found more precipitous places in Switzerland or in any other country, but living in Belgium, we preferred to take an example near our own place. The great point was to discover some method of printing on an uneven surface. As you know, it is only possible till now to print on an even surface. Very well, this is printed on an even sheet of metal, but it has to be printed in such a way that when the sheet of metal has been forced by hydraulic power into the various forms, the different points will be in their true geographical position. So you see it was a very difficult task, because it was necessary to find a geographical formula by means of which every point would finally occupy its correct position. Everything has to be drawn in the first instance, not in its true position, but in a false position, in order that it may be forced into its correct place. If this model is examined carefully, it will be found that every point is in its true position. I am very pleased to be allowed by Mr. Patteson to offer this first example to the Royal Geographical Society of England. Some metals are not suitable for this kind of work; for example, zinc would be torn to pieces by the great pressure, which is about 80 tons: this is of the best red copper; aluminium might be used also. I do not know very much about the financial part of the business, but I know these models will be handier and more resistant; they will be a good deal cheaper than the ordinary reliefs, and therefore I hope they will be used in all schools.

Before the reading of the paper, the PRESIDENT said: We are always very glad to welcome so distinguished a geographer as our Gold Medalist, Monsieur Elisée Reclus. We are always sure, whenever he addresses us, of having something most interesting and important to listen to. To-day he has promised to give us an account of the relief and other maps which have been lately, I believe, invented for the purpose chiefly of education. I will ask Monsieur Reclus to explain the maps to the meeting.

After the reading of the paper, the following discussion took place:—

Mr. MACKINDER: I need hardly say that I have listened with the same pleasure that I am sure every one in this room has to our distinguished brother geographer from across the sea. M. Reclus has been at work on these new cartographical methods, as I happen to know, for some years past, and I may say that we already have at Oxford a copy of the map of the western portion of the Mediterranean, which I see here exhibited as a sample. I would like, if I may, to take this opportunity, when so many who have influence in the matter of geographical teaching are here present, to urge that in connection with our new public authorities, we should try to convince people that in order to teach geography properly, it is necessary to spend more than has been spent upon material. For young children especially, good and abundant material is very important. It is true that these models of M. Reclus will cost far less than the old plaster models. Obviously they are much superior from other points of view. I take it they cannot be damaged so easily, and that they can be stored much more easily. But when all is said and done, you will still have to pay considerably for apparatus. At the present time there is a great tendency to employ, in the way of maps, the cheap and nasty. This is partly due to the comparative rarity of critical knowledge as to what is a good and what a bad map, but also partly to the fact that people have not appreciated the damage done to the minds of the pupils if the apparatus is bad.

There are only two other points I should like to put to M. Reclus. I venture to say that what we most want are some convex maps of larger portions of the surface of the globe. We want our students to grasp, for instance, the true form of the North Atlantic. That is an exceedingly difficult thing to drive home, and a false image of it early impressed on the mind has all manner of bad consequences later on. The relative distances across the Atlantic in different latitudes are obviously hard to appreciate when the map is printed on the flat piece of paper. Again, take British North America. The British dominions there must on the flat be either distorted or exaggerated. What we want is a map on the round of the whole of North America. I know M. Reclus may reply that we have globes for this purpose. But the globe is cumbrous and costly; it cannot be hung on a wall conveniently; it has to stand on a table, and is difficult to use with a class. Personally, I feel that for teaching, the most valuable adaptation of these globular maps would be to replace for many purposes the globe itself.

Now, with regard to reliefs, there is one point that appeals to every one who has to do with a plaster model: it is this—that you are looking at the scenery from the bird's-eye point of view; you are looking down upon it, whereas you look ordinarily at scenery from alongside—horizontally, if I may so put it. I cannot help feeling, therefore, that a certain exaggeration may under most circumstances be allowed. Let us consider, for instance, a model of the Alps and the Plain of Lombardy, a very important region in historical teaching. I agree that a well-made map of this region on the flat will of course mean a great deal to a geographer, but I find from experience that most students who examine even an imperfect model of such an area, carry away a vivid impression, such as they would obtain

from no map. Yet if you represented that region of the Alps and the Plain of Lombardy on the true scale, you would not get a sufficient relief to produce any effect. We must beware of becoming purists in this matter of cartographical truth. After all, the model is rather a weapon of teaching than a means of investigation. In schools time is limited, and you must be content with producing an impression of relative truth and producing it quickly, and afterwards the fact of exaggeration can be separately impressed. Of course, I am not now speaking of models of quite small areas like the Cape peninsula, which can be represented on the same vertical and horizontal scales, but rather of relief maps.

It is quite clear that M. Reclus with Mr. Patteson has got hold of a method which admits of rapid and accurate multiplication of models by means of hydraulic machinery and of a great reduction of cost.

Mr. RAVENSTEIN: I am sure we are all delighted to see so distinguished a geographer as Prof. Reclus amongst us in what apparently is perfect health and in such excellent spirits. I have but little to say on the subject before us, because Mr. Mackinder has anticipated me in many respects. The scale of the maps of the continents in all our good school atlases is identical. But as, for educational purposes, we require maps of particular portions of the Earth, and often of certain towns, we must necessarily introduce other scales, which bear, however, a definite proportion to the scale of the general maps. Multiplicity of scales ought, of course, to be avoided. Now coming to relief maps, and to globes especially, I thoroughly agree with Prof. Reclus as to the system on which geography ought to be taught. There is no better method than the so-called *Heimatkunde*, which teaches a child by personal observation of geographical features. We geographers claim the Earth as our domain. Geologists and botanists may claim a particular kingdom of the Earth, but we claim the whole, and therefore on our school excursions we do not teach our children to look only at the shape of the land; for when a child asks the name of a plant, and why some plants are confined to marshy soil and others to the dry uplands, we cannot tell the child that this is not geography, and send it to some other teacher for information. Our children ought to be trained to observe all things. It is very curious that when I was a boy I read a good many advertisements—they were mostly from ladies' schools, and I think the ladies are sometimes far in advance of us in this respect—in which it was stated that "the use of the globes" would form one of the subjects taught. But where are globes used now? I think the equipment of no school can be considered complete without a globe. No man who calls himself a geographer, or who claims some knowledge of geography, and wants to read his newspaper intelligently, ought to be without a globe on his table. It is one of the most useful things; there is no apparatus like it. You can measure long distances on it, and there is no map on which you can do the same except in a roundabout way. Now, coming to models, I may remind Prof. Reclus that more than sixty years ago my own father, in conjunction with Bauerkeuer, introduced a method of producing cheap reliefs by embossing maps printed on paper. More recently Major Cybulz and others produced beautiful reliefs by a galvanoplastic process; these, however, had to be coloured by hand, and were consequently expensive. I must admit this, that the method of producing models recommended by Prof. Reclus yields results which are superior to anything done hitherto. I certainly think we ought, in every school, to have a number of typical relief maps, and if these typical relief maps are done on a large scale, we might in most instances do without exaggerating the vertical scale, because they could be taken up in the hand and the relief could be studied from different directions. But in addition to these large-scale reliefs, we are to have those discs which M. Reclus promised us on a former occasion, and which would include entire

continents or larger surfaces of the sphere, and if those discs are to show the relief of the ground, then I do agree with Mr. Mackinder that we ought to exaggerate the vertical scale. If you look at Signor Pomba's beautiful model of Italy, now at the South Kensington Museum, and upon which there is no exaggeration of the vertical scale, you can certainly trace the Alps, and they do not impress you as constituting that formidable obstacle between north and south which they constitute in reality. I do think that if Signor Pomba had exaggerated his heights, his relief would have been more effective. And if this applies to the Alps, how much more would it apply to our hills in Wales or Scotland? They would almost disappear, and we should gain no correct notion of their actual height, and the formidable labour required to climb some of them. We all feel grateful to M. Reclus for having once more brought that important subject before us.

Dr. HERBERTSON: We are all very much indebted to Prof. Reclus for bringing these curved maps and models, which Mr. Patesson has constructed under his direction. A year and a half ago M. Reclus was good enough to present one of the curved maps to the School of Geography in Oxford, and I have constantly used it. It seems to me we cannot exaggerate the importance of having a collection of uniform maps constructed on a spherical surface such as M. Reclus proposes to make, more particularly for reference purposes.

In connection with the question of the scale of models, it seems to me that we ought, as far as possible, to have models, not merely with the true vertical scale, but also with exaggerated heights; just as in making a section through a country we draw it first of all on a larger scale to show details, and then reduce it to obtain the true slope. If we take the Thames basin, for instance, it is quite impossible to make a model on the true scale from the 1-inch map. For many purposes a model of the Thames basin on the 1-inch scale is valuable, but in order to make one we have to exaggerate the heights considerably. In teaching the morphology of the land it is necessary to use every possible variety of material, especially for regions which students cannot see—maps of all scales and models of all scales. Every different way of representing the land's surface has a certain merit, and serves to show some detail in a better way than others. It is only by comparing various methods of representing the surface of the land that we come to have a true conception of it. The typical models at a cheap rate will be a great boon to all teachers of geography, and I thank M. Reclus for showing us the beautiful specimens of maps and models which he has brought to-day.

Prince KROPOTKIN said he thought the models which M. Reclus had brought were certainly a great step in advance in the real teaching of geography, and anything which would tend to produce such models at a cheap rate would be another step in helping to spread a true knowledge of geography. With regard to the question of whether such models ought to be made true to scale, he pointed out several of the drawbacks which models with an exaggerated vertical scale were offering for the spreading of correct ideas concerning geological phenomena (glaciation, etc.); but he agreed, also, with Mr. Mackinder and Mr. Ravenstein as to the necessity of having two different sorts of maps. How would it be possible to represent, for instance, the plateau of the great continent of Asia, 3000 feet high and 2000 miles wide, if they were not allowed to exaggerate the vertical scale to a certain extent or even to a great extent—even so much as ten times? Again, in Kent, a difference of 100 feet in the altitudes sometimes made all the difference between the healthy ground of the plateau and the unhealthy clay of the lower levels; it must be shown on a relief map; and if it was intended to represent Kent on a scale where 100 by 300 feet would be a noticeable feature, it would be necessary to increase the size of the relief-map beyond all bounds. The vertical scale

has thus to be exaggerated. But as a corrective to that, after having shown a model on an exaggerated scale, they ought immediately to show one true to scale. He thought maps constructed both on the real scale and the exaggerated scale ought to be found in every well-appointed school. When so much money was spent on useless things, such as ironclads and the like, surely they ought to be able to find the money for what was absolutely essential in carrying on the work of education! He was also very much in favour of the wider use of globes. Children and students ought to have something which would really represent the Earth. It had been urged that globes were expensive. Well, so long as the demand was small they were likely to be expensive, but let the demand be great, and there would be hundreds of inventors ready to supply well-made globes at a comparatively small cost. In conclusion, he congratulated M. Reclus on his perseverent efforts in obtaining true representations of the Earth's surface, and Mr. Patesson on having made the discovery of a practical method for making relief-maps.

Mr. ANDREWS: There is one lesson which I think is more important than any other that we can draw from the excellent exposition M. Reclus has given us, that is to try to get as near as possible to nature. In early days we were content merely to look at shadows, like Plato's prisoners in the cave; now by means of pictures and accurate representations of the Earth's surface in different forms, we are trying to get some idea of what countries are really like, and when we deal with history we try to realize the character of the passes or of the regions through which armies marched, and of the various difficulties and obstacles that lay in their paths. Now, this attempt to get near first-hand knowledge seems to me to be the root of the matter in geographical success. There is still a tendency to make geography merely a record of statistical information. I think that we try to do a great deal too much—that is to say, that we make a mistake in trying to cover the whole area of the world. It would be very much better if we first of all worked out more thoroughly certain detailed areas. We forget that what we have to teach is not statistics, but a method of understanding geographical information which will enable students to use other factors and data when they come before them in their after-career. Therefore I think what M. Reclus has said this afternoon, and what he has shown us in these most admirable maps, should be very valuable from this point of view, if it also enforces the lesson that to get more first-hand knowledge and to study in greater detail a small portion of the world, and to understand the relations of the different phenomena in that district—such as, to take an instance, mountains and forests, and their connection with life and history—is of more value, and will help more to form a habit of thought, which should be the aim of our geographical teaching, than to look at shadows all over the world. I have nothing more to add except to emphasize this very important point, the treatment of some part, at any rate, of our work, the study of a small area in a more detailed manner. I can only thank M. Reclus for his most valuable and interesting exposition.

Mr. COBDEN SANDERSON: I only wish to intervene for one moment. The gentlemen who have hitherto spoken have, I think, been all geographers conversant with the subject and with matters of geography fully in their mind. I beg to speak as a layman in this matter, and as a layman to thank M. Reclus not only for the construction of these maps and for his contributions to geography proper, but as an inspired teacher of geography, who shall not merely communicate to us knowledge of the facts, but shall excite our wonder and admiration for the world itself, which is the subject of geography. It is for that contribution to human knowledge and human aspiration that I beg as a layman to thank M. Reclus for his life-long contribution to the great work of humanity.

Prof. RECLUS: I have to thank you, and especially Mr. Mackinder and Prof. Ravenstein and Dr. Herbertson, for what you have said with regard to the usefulness of globular discs, and especially of those which would represent a large part of the Earth's surface. I speak here, not as a geographer, but as an artist; and I think nothing would be more wonderful than to have a model of very extensive parts of the Earth, with the real curvature and the real proportion shown, in such a place, for example, as this hall of the Royal Geographical Society. You would then have an opportunity of seeing the whole of the globe as well as the various parts. It is very difficult when you see only Spain and the South of France, and the western shores of the Mediterranean, for instance, to realize that it is only about 150th part of the Earth. That is because the curvature is very small; but with the curvature very large, you would immediately say this is a tenth or a twelfth or a fifteenth part of the surface of the Earth, and so would get a clearer idea of the relative proportion of that part of the country with which you were dealing. I think the idea is to be realized, and I thank you for having hinted at it. But now another thing—the real and vertical scale. I do not agree with the remarks of all these gentlemen, although I think it is necessary sometimes to exaggerate in scientific demonstrations. For instance, if you want to show the different tracks for the tunnelling of the English channel between France and England, you would not see the mere line which is made by the sea, and so you are obliged to deepen that ditch between France and England, and to show that it has a certain depth you are obliged to exaggerate. There are occasions in teaching where exaggeration is absolutely necessary. But then I think it would be better to have the two things, to have the exaggeration which could be shown on the map, and the true line to show the true state of things. Now, some one referred to that beautiful map of M. Cesare Pomba. I am a great admirer of it, and I think it is a very good idea to show Italy with its true curvature and the Alps in their true proportion. When we see them on a model in their true proportion, we are generally astonished, and perhaps say, "They are not very high; I thought they were higher. When I am in Milan or Verona and see them before me, they seem so majestic; of course they must be higher than that." And so we lose our illusion. But I think the reason for this is because we have had a bad education. For example, in certain atlases we see France with its mountains, and not only the Pyrenees and Alps, but also the mountains of the interior, and they are shown in such an exaggerated way, in proportion of one to five or more, and then we say: "How splendid, how well-shaped that relief is! that map is very nice." But it is false; and taught by that, you are led to think that nature has more relief in reality than she has. I think we ought to keep as much as possible to the truth, and if relief is not sufficient to show itself, then let us represent it by a difference of colour. For example, in this map of Spain we have tried to show all the heights from 1000 to 3000 metres and more by a difference in colour, because it is impossible to represent them by real relief. I think there are two schools, one of perfect truth, and the other with a certain condescension towards the illusions. Well, I think this second school is not the good one. As a descendant of the old Huguenots, I prefer sticking to truth.

The PRESIDENT: I think, before I ask you to pass a vote of thanks to M. Reclus, I ought to say that we as a society are bound to further the views which we believe to be correct, and which M. Reclus has expounded to us now on two occasions when he has been so kind as to pay us visits here. He has impressed upon us the importance of the use of globes, and the importance of teaching by means of globes. He has reminded us that in the days of the Renaissance they were universally used. Sir Francis Drake and Cavendish and

Frobisher certainly took globes like that to sea with them, and puzzled out their problems on the globes, and it is far easier to understand problems in geography by using a globe, than by drawing imaginary spherical triangles on a plane surface. I understand from Mr. Reeves that he has now introduced the plan of teaching nautical astronomy and the problems of geography by means of globes. M. Reclus has pointed out to us the importance of these relief maps, to enable us to understand that we are looking at a rounded and not at a plane surface. And then with regard to the larger-scale maps, he has, after much thought, adopted Mr. Patteson's plan of using metal and printing on it, instead of the old plan of moulding. These improvements are all very important for educational purposes, and as he has most kindly, as I understand him, presented our Society with these two models, it will be our endeavour to make his plan known as widely as possible amongst men engaged in education, and so we trust that this immense improvement—and it certainly is an immense improvement—in the method of teaching geography will gradually be introduced into this country, and that a large demand will arise for these relief maps. I would ask you to pass a vote of thanks to M. Reclus for his great kindness in coming over here to address us, and for bringing with him these maps for our instruction and use. I ask you to pass a vote of thanks by acclamation to M. Reclus.

ANTARCTIC SLEDGE TRAVELLING.

By the PRESIDENT.

THE great work of the Antarctic Expedition was achieved by sledge travelling, and the clearest way of giving an idea of the extent of this work is by presenting it in tabulated form. The autumn travelling occupied from February 18 to April 3 under most rigorous conditions of climate.

The spring travelling comprised two main expeditions to the south and inland to the west, two supporting parties, and one depôt party.

There were also ten reconnoitring parties to explore the region nearer the ship. Five went out in the intense cold of the early spring—one towards the mainland to south-west, another towards the mainland to west, and three to examine the island of the volcanoes. Of the five later parties, one was to Cape Crozier, another along the west side of Mount Erebus, two to the land to the south, and one to explore a smaller volcanic island. Altogether eighteen sledge parties.

AUTUMN TRAVELLING.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Feb. 18-22	**Shackleton** **Wilson** **Ferrar**			5	To the island 15 miles south-south-west. Ascended peak of island, 2720 feet, and found clear road to the south. Returned with considerable information as to **the lie of the land.**

Date.	Officers.	Men.	Temp.	Days.	Remarks.
March 3–20	**Royds** **Skelton** **Koettlitz**		−42°	17	To go round Mount Terror. Captain was going, but he sprained his knee. Eight dogs. Snow very soft. March 7, Barne went back with men, the other three proceeding on ski; but unable to reach Cape Crozier.
March 3–12	**Barne**	Evans Quartly Wild Vince Hare Weller Heald Plumbley		9	Barne reached crest of hills on March 11. Heavy gale and drift. Party left the sledges and made for the ship. Vince fell over precipice into the sea. Hare under snow for thirty-six hours. Rest found their way to the ship.
March 31 to April 3	**Captain** **Wilson** **Armitage** **Ferrar**	Dellbridge Macfarlane Walker Blisset Feather Smyth Allen Williamson	−40° −48° −57°	4	Loads too heavy. Four sledges and eight dogs. Only got 7½′ from ship. Cold intense. With twelve men and the dogs. Dogs all refused duty. Two sledges and nine thermometers left behind. Men suffering severely after reaching barrier surface. Too cold for camping out. Object was to place a depôt, but decided to return.

Autumn travelling was first undertaken, in polar work, when McClintock was away from October 2 to 10; Aldrich, October 2 to 6; and Mecham 5 days, laying out depôts in 1850. In 1875, in the same month, Markham, Parr, and May were away 21 days, Aldrich 13, and Egerton 4. It is excessively severe work.

Scott considers the autumn journeys to have been useful because they gave experience, and when the spring came he felt that he "could not be sufficiently thankful that most of us had had an opportunity of spending a few days in the autumn travelling." The furious gales and very low temperature made it more severe work than in the Arctic autumn travelling.

MAIN SOUTH JOURNEY.

Depôt Party.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Sept. 17–19 Sept. 23 to Oct. 4	**The Captain** **Shackleton** **Barne**		Heavy gale, −51°	10	With the dogs. Such a hurricane that they had to return on 19th. Barne badly frost-bitten.
	Shackleton **The Captain**	**Feather** (*boatswain*)			Started again on the 23rd. To **Depôt A**, 60 miles south of the ship and 8 miles from the land, 79° 45′ S.

Supporting Party.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Oct. 29 to Nov. 24	**Barne**	Feather Dailey Crean Handsley Joyce Kennar Smyth Weller Williamson Pillbeam Buckridge		26	Accompanied the main party to **Depôt A**, Nov. 11. Return journey Nov. 15–23.

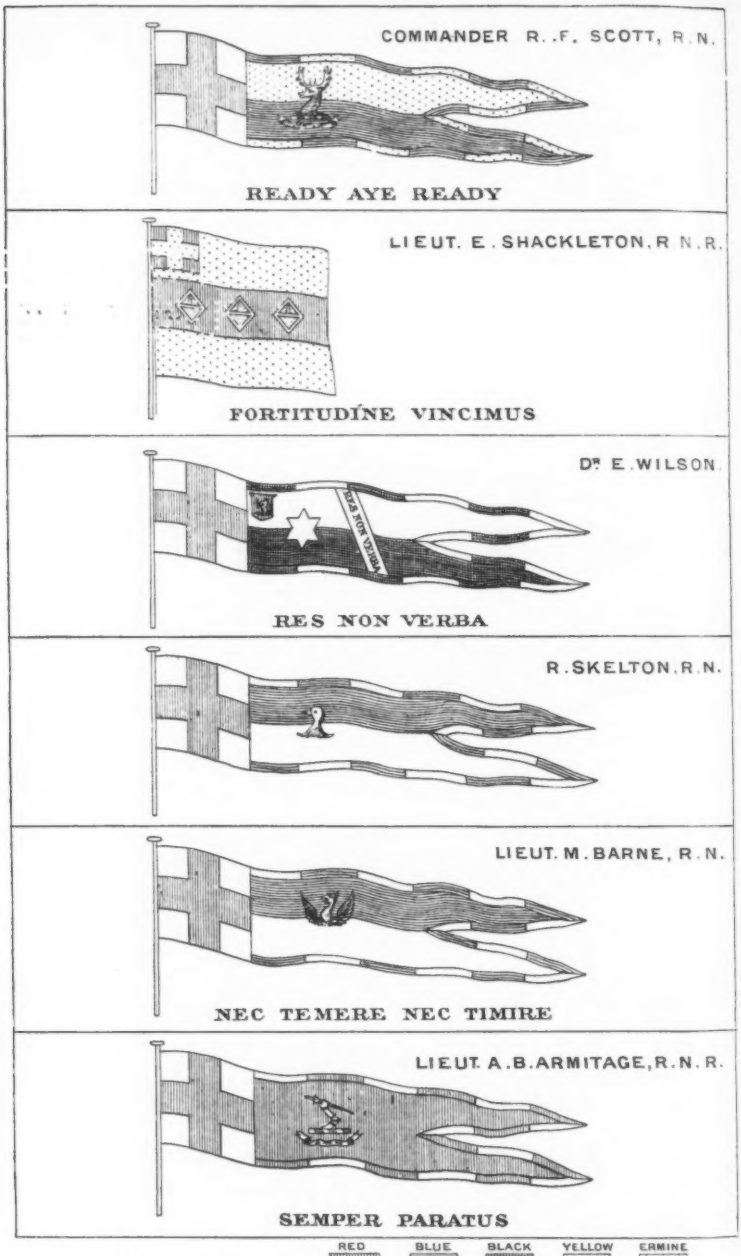
Main Party.

Date.	Officers.	Dogs.	Temp.	Days.	Remarks.
Nov 2 to Feb. 5	**The Captain** **Shackleton** **Wilson**	1 *Snatcher*, *d.* Dec. 9 2 Vic „ 16 3 Wolf „ 19 4 Granny „ 20 5 Brownie „ 26 6 Clarence „ 31 7 Spend, *d.* Jan. 1 8 Nell „ 2 9 Guss „ 3 10 Bismarck „ 4 11 Boss „ 5 12 Kidd „ 5 13 Birdie „ 10 14 Joe „ 10 15 Lewis „ 11 16 Nigger „ 15 17 Jim „ 15 18 Blanco 19	−30°	94	All the dogs, but they began to fail on Nov. 15. Nov. 16 to Dec. 16, relay work in soft snow; 15 miles for 5 made good. Dec. 16, **Depôt B**, 3 weeks' provisions. Went south with 4 weeks'. 80° 30' S., 162° E., 7 miles from a headland. Dec. 30, reached **82° 17' S.**, 163° E. Attempt to reach land. Jan. 1, dogs useless. Jan. 9, dogs unharnessed. Jan. 13, two days' provisions left. B. Arrived depôt B. Jan. 15, breakdown of Shackleton. Scott and Wilson pulling **270 lbs.** each. Jan. 28, **Depôt A.** **853** geographical miles. **973 stat. miles.**

MAIN WEST JOURNEY.

Supporting Party.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Nov. 29 to Dec. 18	**Koettlitz** **Ferrar**	Hubert Dell Whitfield Clark Dellbridge Croucher		20	To accompany the main west division for ten days. Turned back December 9.

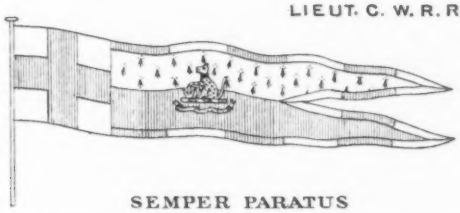


SLEDGE FLAGS OF THE

Dr R. KOETTLITZ

NIL SINE LABORE

LIEUT. C. W. R. ROYDS, R.N.

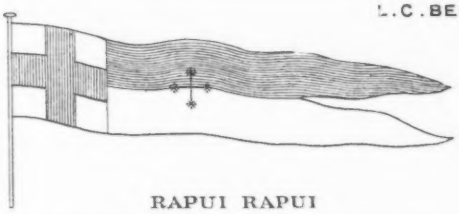


SEMPER PARATUS

H. J. FERRAR

FERRÉ VA FERME

L. C. BERNACCHI



RAPUI RAPUI

J. V. HODGSON.

DREAD GOD

Reference for Flags ..... RED BLUE BLACK YELLOW ERMINE

"DISCOVERY" EXPEDITION.

Main Party.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Nov. 29 to Jan. 19	**Armitage** **Skelton**	Evans Macfarlane Gilbert Scott R.M. Walker Quartly Allen Handsley Wild Duncan Buckeridge		53	Dragging **240 lbs.** per man. 29 miles over sea-ice, then 19 miles up a snow-filled valley to the foot of mountains 11,000 feet high. Had to work by relays; 4500 feet. A week trying to ascend a mountain. Descended 2000 feet on to a glacier, then always ascending for the next 50 miles, with crampons. Left six men at 8000 feet, sick from altitude. Reached 9000. Officers and four men. Jan. 6, 38 days out; 14 days returning. **141·5 stat. miles** from ship (**122·7** geographical miles), **77° 21′ S., 157° 26′ E.** 537 stat. miles.

EARLY SPRING PARTIES IN EXTREME COLD.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Sept. 2–7	**The Captain** **Shackleton** **Skelton** **Wilson** **Ferrar**	Feather	−50°	5	With fifteen dogs: to examine the **bay and islands,** and the glacier **north of winter quarters.**
Sept. 10–19	**Royds** **Koettlitz**	Lashly Quartly Wild Evans	−52° Heavy gales	9	Attempt to reach **mainland** to **south-west,** and explore Mount Discovery.
Sept. 10–24	**Armitage** **Ferrar**	Cross Heald G. Scott, R.M. Walker	−45	14	To reach **mainland to west.** Came to a glacier on the mainland, and ascended it. Came back in a broken-down condition: Ferrar, Cross, and Heald with scurvy. Ferrar's life was saved by Heald.
Sept. 24 to Oct. 2	**Koettlitz** **Bernacchi**	Dailey		8	To **Brown and Black islands.**
Oct. 4–25	**Royds** **Skelton**	Evans Lashly Quartly Wild	−40° every day; once −58°, lowest recorded while travelling. Furious gale 5 days	21	To **Cape Crozier.** Skelton, roped with men, made a wonderful descent to the sea-ice. **Found the record.** Royds suffering from cramp.

EXPLORING PARTIES IN THE SUMMER.

Date.	Officers.	Men.	Temp.	Days.	Remarks.
Nov. 3–20	**Royds**	Royds Plumley Blissett, R.M. Merton Macfarlane Allen Dell supporting	Gales 7th, 8th, 11th, 12th.	17	To **Cape Crozier.** Record left —"*All well, Nov.* 2." Found by Colbeck, Jan. 18, 1903. **Emperor's egg** found. Brought back many eggs. The three last men for a day to give a start.
Nov. 3–7	**Skelton** **Koettlitz**	Hare		4	To the **glacier snout,** and Razor-back Island in the bay, to look for rookeries. On **lower slope of Mount Erebus.**
Dec. 20 to Jan. 30	**Barne**	Smyth Plumley Dell Handsley Williamson Crean		40	To **depôt A,** two sledges, 1148 lbs. Went beyond A, exploring the coast to **79° 50′ S.** Turned back Jan. 14. Back at A Jan. 24.
Dec. 29 to Jan. 8	**Koettlitz** **Hodgson** **Ferrar**			11	To explore **Brown Island.** Ascended 2750 feet to its summit. Found a **volcanic cone and crater.**
Jan. 14–26	**Koettlitz** **Ferrar**			12	To examine and explore the **Bluff.**

POLAR JOURNEYS COMPARED.

Year.	Name.	Dist. in stat. m.	Days.	Remarks.
1853	McClintock	1328	105	1629 lbs. of fresh meat. *No dogs.*
,,	Mecham	1163	94	1460 lbs. of fresh meat. ,,
1854	Mecham	1336	70	1 reindeer, 3 hares, 30 ptarmigan. 20′ a day! *No dogs.*
1903	**Scott, Wilson, and Shackleton**	973	94	*Dogs* for first fortnight. Afterwards gradually became useless.
1853	Sherard Osborn	935	92	*No dogs.*
,,	Richards	840	86	,,
1851	McClintock	770	81	,,
1853	Vesey Hamilton	675	55	,,
1876	Aldrich	630	84	,,
1853	Nares	630	57	,,
1876	Markham	600	72	,,
1851	Ommanney	480	60	,,
,,	Sherard Osborn	534	58	,,
1903	**Armitage and Skelton**	600	52	Over difficult mountains and glaciers. *No dogs.*
1903	**Barne**	500	40	*No dogs.*
1854	Roche	590	39	*With dogs* entirely. ,, ,, ,,

ON SOME NEW LAKES AND A LITTLE-KNOWN PART OF CENTRAL NEWFOUNDLAND.

By J. G. MILLAIS, F.Z.S.

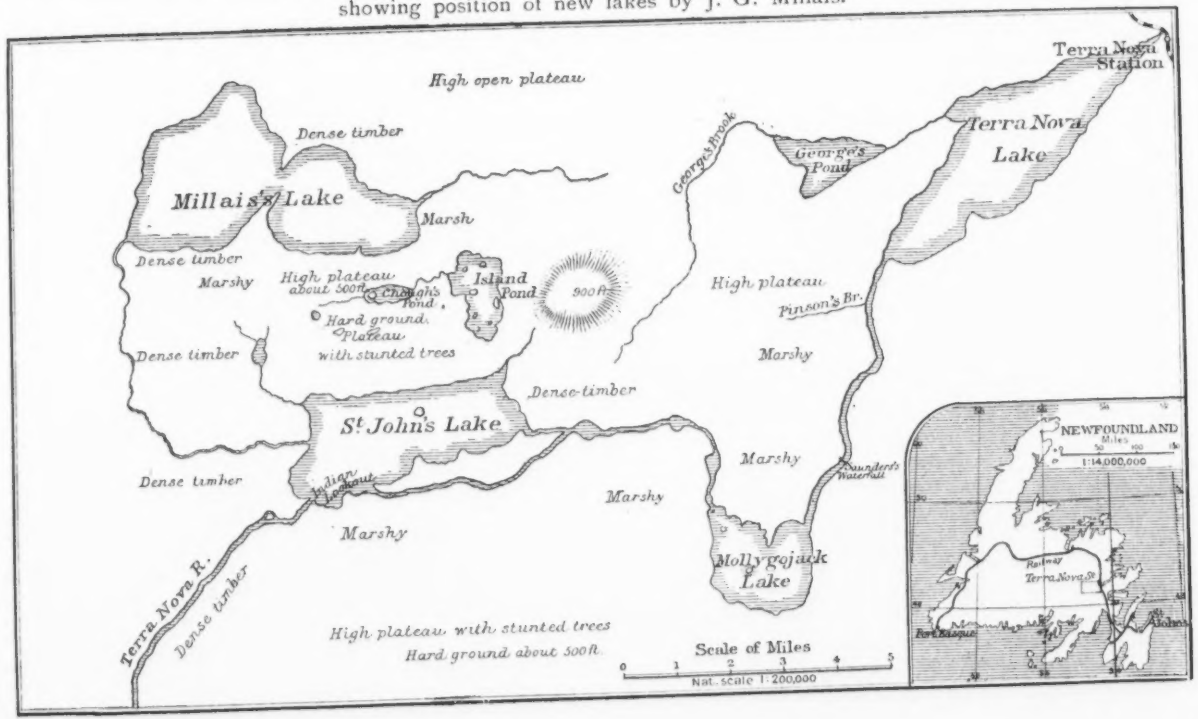
SOMETIME in the eighties the well-known geographer, Mr. Howley, undertook to map as much as possible of the centre and southern part of Newfoundland. For this purpose, he chose a route from the east at Alexander bay. All the coast-dwellers and men who had been a short distance into the interior after furs or caribou said he would certainly fail, owing to the difficulties of transport. However, thanks to the skilful guiding of an Indian and the efficient support of his men, Howley succeeded in getting right up the rocky Terra Nova river, past Mollygojack lake, and along the ground to the north of St. John's lake, where he seems to have roughly mapped the country by eye-sketching; eventually he turned south, and out to the southern coast through the dense country of the Kaegudeck and Meddonegonnix lakes. Howley mapped very accurately his actual line of route and the country within view, and succeeded in making an excellent journey where others would have failed. To this day, however, a very large portion of Central Newfoundland is less known than Central Africa, and much work remains to be done in the square enclosed on the north-west by the Annieopsquolch mountains, on the south-west by the La Poile river, on the south-east by the Meddonegonnix Lake river, and the north-east by the Gander river. The interior of the country, too, lying immediately north of the southern coast is also unknown, no hunting or other parties ever penetrating this region.

Some years after Howley's successful journey, another scientific expedition left the coast by the same route. The leader was a good man and a good geographer, but had little knowledge of Indians and their ways. He knew how to equip an expedition and how to map, but in this case, what was quite as important a matter, he did not possess tact, nor did he know that it was unwise to contradict a red man flatly, and differ on the subject of a country of which as yet he knew nothing. Arrived at St. John's lake, the leader turned to a man from the coast who likewise had never been so far before, and said, "Jim, how long is this lake?" "Fourteen miles, boss," replied the man. "Lake 5 miles long," broke in the Indian. "I'm sure it is double that distance," unwisely suggested the first white man, gazing into the hazy distance. The Indian gave a grunt, and half an hour afterwards the second expedition to St. John's lake was lamenting the loss of its guide. The whole party then immediately returned to the coast.

As each year drove the caribou from the coast, the men from Alexander bay kept following them further and further into the interior. It was considered impossible to work up the Terra Nova river, and few had ever ventured beyond Pinson's brook, where rapids

PART OF CENTRAL NEWFOUNDLAND

showing position of new lakes by J. G. Millais.

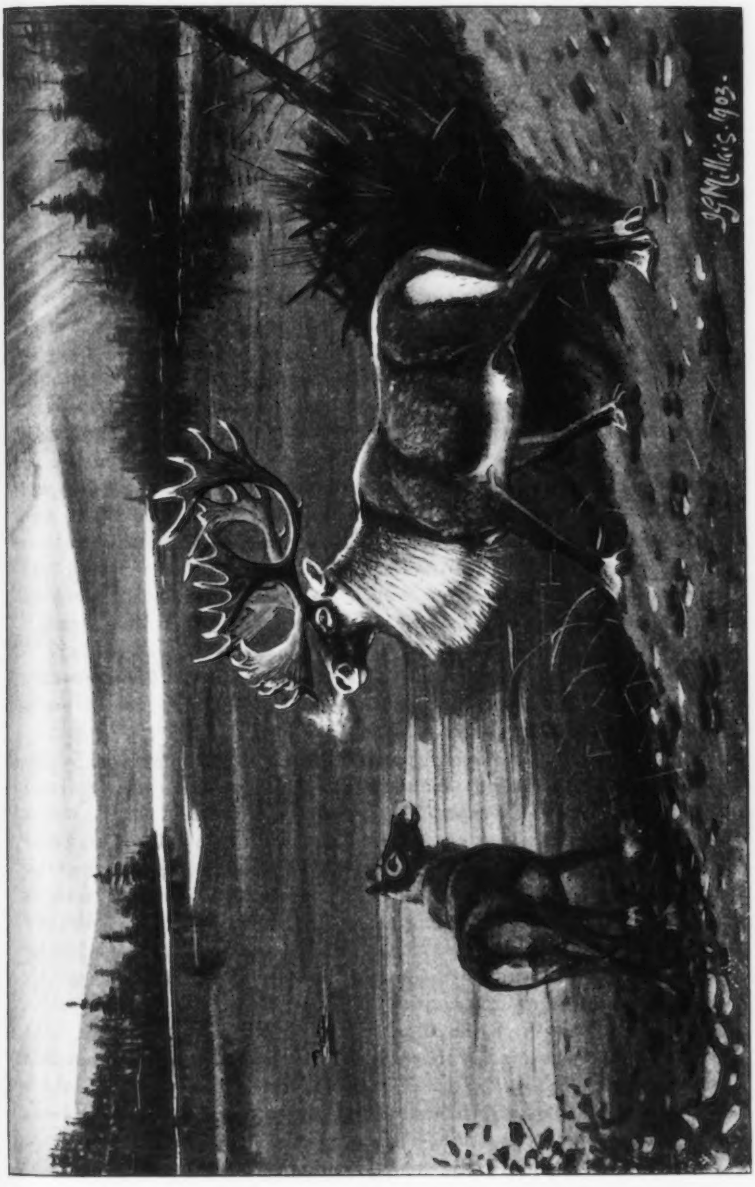


begin. The usual plan was to wait till the ice formed on the Terra lake, and then sledge up this and George's pond to the western end, and hunt the high country on the western plateaux. Every year, however, the caribou kept moving further west, till three years ago the men reached the furthest point which was known to them, namely, "Island pond," a beautiful sheet of water dotted with many wooded islands, and lying immediately to the north of St. John's lake. Here the hunters got all the caribou they wanted in a day, and retired to the coast again without penetrating further.

It was Mr. Frederick C. Selous, the well-known African traveller, who next (1900) trod these wilds after Howley's expedition. Practically in the middle of winter, he made a considerable tramp right across the high plateau beyond George's pond, and as far as the river that comes into St. John's lake at the north-western end. Here food gave out, and he and his packers had to retreat as fast as possible to their base camp on George's pond. With him went one Robert Saunders, an excellent guide, who expressed the opinion to Mr. Selous that it would be possible to ascend the Terra Nova river in the autumn, if proper canoes were taken, and hunt caribou at the western end of St. John's lake, where the deer were expected to be numerous. This Mr. Selous did the following autumn (1901), taking five days to ascend the rivers and lakes, and enjoyed such excellent sport on Lake St. John that it was for him unnecessary to travel further than his base camp, which I have named Indian Lookout.

Thanks to my friend Selous, I obtained his guides in the autumn of 1902, and followed the same route up the Terra Nova. I also made a base camp at Indian Lookout; but not finding caribou here, I crossed the lake to the north-west, and cut a road with the axe through the dense timber up to the high ground above, which I had previously seen with the telescope. There I made another camp, from which I searched all the unknown country to the north-east and north-west by making short expeditions of a night or two, and sleeping out in a reindeer bag.

It is, perhaps, necessary to go back for a little way and say a few words on the geographical features and general appearance of the country on the way up the Terra Nova river. After leaving the railway at Terra Nova station, the traveller passes up a river-lake system of about 4 miles before entering the large Terra Nova lake, which is some 8 miles long. On each side are dense forests sometimes several miles broad, and sometimes as narrow as a mile, this depending entirely on the elevation of the mountain plateaux, which generally rise gradually away from the river to an approximate elevation of 500 feet. Where the ground is flat it is boggy, and the timber exceedingly dense—so dense, in fact, that in most places a man cannot get through without the help of an axe. As the forests rise, however, they become more open, and higher still they are interspersed with little opens,



VIEW FROM NORTH EAST ARM OF MILLAIS LAKE, LOOKING SOUTH-WEST.

locally called small "barrens." The most common trees are white and red pine, dogwood, hazel, rowan, birch, and white poplar, whilst along the river-edges are often dense masses of alder.

After leaving the western end of the Terra Nova lake, the traveller paddles easily up the main stream of the river for 5 or 6 miles until nightfall. During the next two days the current is too strong for boat work, and the river so full of rocks and rapids that you must travel along the stones and boulders by the water's edge whilst your men labour with the canoe, now pulling it through the streams and wading deep to keep the fragile craft from being smashed on the jagged rocks. It is cold and rough work for the men, but Newfoundlanders are used to hardship, and lie down at night without changing, "to steam the water out of them," they say. If you are lucky, you will reach the fine lake of Mollygojack on the third day, a grand sheet of water about 12 miles round, and dotted with a few islands, on which the great northern divers breed. Another day of hard toil for the men and rough walking for the traveller brings you to St. John's lake. This is always a difficult lake to traverse, as, lying almost due east and west, a slight breeze from the west renders it almost impossible to face without getting swamped. We were fortunate, however, on the ingoing journey, having a fine evening on which to paddle over the glassy surface. A female caribou stood gazing at us in the shallows, and flocks of dusky duck (*Anas obscurus*) and Canadian geese (*Anser canadensis*) drifted out of our way as we moved quickly up to the old-time battered tree of Indian Lookout. I thought this would be the end of our journey, but it was really only the beginning, for big stags showed no signs of coming. Consequently I resolved to go and meet them, and moved camp, as I have already described, to the high plateau on the north-west end of Lake St. John.

We are now in completely new ground, where Saunders, who is the pioneer of the hunting fraternity, asserted no white men had ever been in previous years. Everything bore promise of the numbers of caribou that frequent these woods by the abundance of deep time-worn trails in every direction, but the weather being simply perfect, and the temperature that of the south of France, the large stags showed no signs of moving out of their summer retreats, although the does had already commenced to travel. Consequently there was little to be done in the hunting line, so I tramped the country in every direction, taking bearings and making sketches for the small map here figured. Immediately to the north of the ridge above St. John's lake there is a long hollow sparsely covered with stunted larch and surrounded by woods on the west. Taking two bearings of 45° from each end of St. John's lake, and at an apex of 2 miles from the larger sheet of water, we came to a smaller lake about a mile long, which I have called Chough's pond. From this pond runs a little stream flowing due east for 2 miles, where it empties itself into the fine lake of Island pond. Island pond is about

5 miles in circumference. Though Howley must have passed close to the lake in his journey, it is not marked on his or any subsequent map. Except on its eastern margin, where the plateau rises somewhat abruptly to about 700 feet, the surrounding country is much broken and wooded, whilst the lake itself is dotted with numerous small islands covered with trees.

After spending some days to the eastward travelling and sketching, during which I shot two fine caribou stags, I next turned my attention to the north country. Passing directly north in the direction of the headwaters of the Gander, the traveller, after leaving the hollow with Chough's pond, rises gradually for several hundred feet, and finds himself in a wide open plateau composed of "dry ground," *i.e.* hard rock and stunted bushes. The general geological conditions are at once seen to be more northern from the presence of various lichens and arctic mosses, whilst the keen bracing air denotes a considerable altitude. It was from the northern edge of this high plateau that on September 10 we first caught sight of a new lake lying in a great basin surrounded by the usual well-nigh impenetrable forest. Saunders, my guide, at once said that this must be the lake he had once heard an Indian speak of as being a place where he had once speared many deer, but to which he could give no name nor indicate its position. The following day, after making a forced march, we determined to reach the lake and examine its eastern end, where there was a broad barren that joined two great forests. It took us three hours' hard work to make our way in the descent to the lake-shore. The distance from the open ridge to the water was only about 1½ mile, but such close forest I have nowhere encountered in other parts of the world where I have hunted.

Once arrived at the Sandy Beach, at the eastern end there is a glorious view of the surface of the new lake, which Mr. Reid kindly expressed a wish to name after myself. The whole lake is not so broad as St. John's, but it is considerably larger, and carries a greater volume of water. About 3 miles from the eastern limit, two long points of land project into the lake, and give the whole the appearance of an egg-glass. Forests entirely surround the lake, whose sides are for the most part steep, and devoid of beaches. The circumference must be estimated at about 20 miles. At the eastern end there flows in a good-sized stream (heavily stocked with the beautiful onananiche or land-locked salmon), which percolates from the east, rising on the high ground above George's pond, and flowing west down a broad valley about 2 miles to the north of Island pond.

A glance at any map of Central Newfoundland will show a fair-sized river falling into the western end of St. John's lake. It is marked as coming from due west, but in reality it does not come from this direction, but issues from the western end of Millais's lake to the north, where, after pursuing a southerly direction for some miles, it turns

gradually to the east till it enters St. John's lake at the point indicated. During the following week I packed over and made a camp by the new lake, where I remained hunting and sketching for a fortnight. During this time I traversed all the vicinity through, not surmounting the high ridge to the north, which divides this country from the Triton brook, and which is also practically unknown.

THE EIGHTH INTERNATIONAL GEOGRAPHICAL CONGRESS.

THE arrangements for the Eighth International Geographical Congress, which, as is known to readers of the *Journal*, will meet next year at Washington, are now taking shape under the care of a committee (presided over by Prof. W J McGee) representing the ten geographical societies and mountaineering clubs of the United States, which have united to welcome the geographers of all nations to American soil. According to a circular issued in June last, the Congress will meet in Washington on September 8, 1904, and will hold daily sessions on the 9th, 10th, 12th, 13th, and 14th of the month. Arrangements have been made provisionally for an excursion from Washington to St. Louis, *viâ* Baltimore, Philadelphia, New York, Niagara falls, and Chicago, between September 15 and 20, during which the Congress will be entertained by the Societies having their head-quarters at places on this route, the foreign members and associates being, it is expected, the guests of the ten societies collectively. At St. Louis, the members and associates of the Congress will take part in the International Congress of Arts and Sciences connected with the Louisiana Purchase Exposition, where a geographical exhibit is also planned. In case any considerable number of members so desire, a general excursion will be arranged from St. Louis *viâ* Laredo and the Mexican railway to the City of Mexico, thence *viâ* the Mexican Central and El Paso to Santa Fé, and so to the Grand Cañon of the Colorado and on to San Francisco and the Golden Gate, where the Western Geographical Societies will extend special hospitality; afterwards returning by way of Mount Shasta, Portland, and Mount Tacoma, and through the Northern Rocky mountains and the interior plains to the eastern ports. It is expected that special rates, from 25 to 40 per cent. below the ordinary, will be secured on this excursion.

The subjects for treatment and discussion during the meeting at Washington are classified under the following heads:—

1. Physical Geography, including Geomorphology, Meteorology, Hydrology, etc.
2. Mathematical Geography, including Geodesy and Geophysics.
3. Biogeography, including Botany and Zoology in their geographical aspects.
4. Anthropogeography, including Ethnology.
5. Descriptive Geography, including Explorations and Surveys.
6. Geographical Technology, including Cartography, Bibliography, Orthography of place-names, etc.
7. Commercial and Industrial Geography.
8. History of Geography.
9. Geographical Education.

The committee urge that early notice be given by those desirous of presenting communications or proposing subjects for discussion, July 1, 1904, being fixed as the latest date for submitting communications designed for printing in connection with the Congress, and August 1 in the case of abstracts (not exceeding 1000 words in length) designed for insertion in the daily bulletin.

Except in special cases, it is anticipated that not more than twenty minutes can be allotted for any communication, and in cases where no statement is made by the author as to the time required, only twelve minutes will be allotted. All papers presented, and subjects proposed for discussion, will be submitted for approval to a Scientific Committee, whose decisions shall, however, be subject to revision by the presidency after the Congress meets. Communications may be written in French, English, German, Italian, or Spanish.

The Committee of Arrangements extends a special invitation to geographical and cognate institutions to participate in the Congress through delegates, who will be expected to subscribe as members, though the publications of the Congress will be sent free to all societies represented. Membership (which entitles to the receipt of all publications) may be acquired by payment of $5, or £1; while ladies accompanying members may become associates on payment of half that sum, enjoying all the privileges of members except the rights of voting and of receiving publications. It is asked that those who intend to be present, or desire to receive the publications of the Congress, will send in their names at the earliest practicable date.

It will be seen from the above that every effort is being made to make the eighth meeting of the Congress as much a success from every point of view as its predecessors have been, and it is to be hoped that large numbers will avail themselves of the exceptional facilities offered, not only of enjoying intercourse with the geographers of the United States, but of gaining an insight into the broad geographical relations of the North American continent.

REVIEWS.

EUROPE.

Botanical Expedition to Corsica.

'Botanische Reisestudien auf einer Frühlingsfahrt durch Korsika.' Von Dr. M. Rikli. Zürich: Füsi & Beer. 1903.

In company with friends, Dr. Rikli, in the spring of 1900, made an excursion to Corsica to study the vegetation and other features of that island. The results obtained have been embodied in the small book above mentioned, which is illustrated by twenty-nine reproductions of photographs.

Corsica is an extremely rocky and mountainous island, the scenery as a whole being as often hopelessly monotonous as remarkably grand. The Spelunca near Evisa is an example of the latter. Geologically speaking, Corsica is in structure very similar to Sardinia, though some peculiarities have important effect on the appearance of the scenery. The rocks and mountains are generally brilliantly coloured, red predominating. These colours are due to red porphyry and granite, green serpentine, and many other minerals. Many of the rocks are corroded in a remarkable manner, on account, no doubt, of their not being of homogeneous structure.

The vegetation of Corsica is of great interest, as, owing to the restricted area under cultivation, much of the country is practically in a wild state. A few of the chief characteristics of the Corsican flora are recorded. Many of the species appear in large quantities and over large areas in almost pure formations, and not mixed with other species. The island has probably about two thousand different vascular plants—a very large number for such a small district. An explanation for this may possibly be found in two peculiar features noticed by the author. Many of

the plants have a very short season; they soon disappear and make room for other species. Then, again, numerous local floras are found restricted to small areas, and dependent on some local peculiarity in the external conditions. The limestone flora of Bonifacio is an instance of this. The formations of the lowlands bear an essentially xerophil character, except along the watercourses. Higher up, however, in the hills hygrophil formations of beech forests are met with. Three regions may be distinguished when passing from the lowlands to the highest points on the island. The lowest region, which is mostly under cultivation, rises up to 900 metres. The vegetation is essentially of the Mediterranean sclerophyll type. The mountain region, 900 metres to 1800 metres, begins with the upper limit of the Spanish chestnut, and extends to the upper limit of the beech forests. The alpine region includes the remainder up to 2710 metres. Grassland with low-lying shrubs is found here. But this region is not covered by a continuous coat of vegetation, this being frequently interrupted through peculiarities in the formation of the substratum.

The different formations are discussed in detail, and many other points of geographical, geological, botanical, and even ethnographical interest are referred to. The photographs bring out clearly the general character of the scenery, and more especially of the vegetation. O. V. DARBISHIRE.

ASIA.

ASIATIC RUSSIA.

'Asiatic Russia.' By George Frederick Wright. With maps and Illustrations. Two vols., pp. xxii., 637. London and New York. 1903.

This work, due to the enterprise of an American geologist, was originally planned as a study in physical geography, and took its present form as a result of the author's journey through China, Siberia, and West Central Asia. In this journey his special object was to study the conditions of the Asiatic "backbone" regions during the glacial period; but from physical research Dr. Wright was led on to examine the political and social facts—past and present—of the country visited; and thus the present volumes grew into shape. The keynote of these volumes is the connection of physical and human history in Asiatic Russia, and the need of studying both together. After the "Physical Geography," therefore (pp. 13–120), comes the "Russian Occupation" (pp. 123–340); next follow the "Political Divisions" (pp. 343–416), and the "Social, Economic, and Political Conditions" (pp. 419–481); and the work ends with a study of the "Natural History," the geology, climate, fauna, and flora (pp. 485–581). Under "Russian Occupation" we have a history of the Slav conquest of Siberia, Turkestan, and Caucasia, a very interesting inquiry into pre-Russian colonization, largely based (for Siberia) upon the collections of the museums at Minusinsk and Khabarovsk, and a detailed study of the immigration and settlement, both penal and free, of the Russians themselves. In this connection it may be regretted that a map in Lansdell's 'Central Asia,' showing the areas of Russian colonization, could not have been taken as a model for a fresh and up-to-date portrayal of the ethnological facts of Western Turkestan. Under "Political Divisions" we have a brief but decidedly useful "gazetteer of regions," affording a digest of all the more important facts of population, production, inter-communication, education, and physical environment. Under "Social Conditions" the author gives an excellent summary of the chief lines of road, rail, and river navigation, a carefully considered estimate of "capacity for development" under various heads—population, agriculture, irrigation, transport of goods, manufacture, and industry—and certain "grounds for confidence in the future" of Russian progress; while under "foreign relations" he touches cautiously but cheerfully upon the great political problems ahead of Russia in Asia. The whole area between

the Yenisei, the Ural mountains, the ranges along the southern Turkestan border, and the dividing chains from the Pamir to Lake Baikal, is considered by Dr. Wright to have been the scene of a great subsidence in recent geological time. During this subsidence, as our author believes, the fertile soil, called "loess" in some regions, and "black earth" in others, was accumulated; the waters of the Arctic ocean covered all North-West Siberia and extended up to the base of the great Asiatic plateau; and when the ocean retired, it left the seals of the north behind it in the two isolated basins of Baikal and the Caspian. The sections of the present work on Russian colonization in relation to the Church and the Raskolniks, to the Village Commune, to the system of compulsory migration applied to "undesirables" by the village community, and to the system of free peasant emigration organized and controlled by the Central Government (for the more recent settlement of Siberia), are especially worthy of study; and not less so is Dr. Wright's analysis of the criminal statistics, showing that about 50 per cent. of all the Siberian exiles of the past consisted of persons banished by the village communities, forming 99 per cent. of those reported as banished by "administrative process," or by order from the Minister of the Interior. The author is conspicuously successful in his endeavour to present a picture of the actual contemporary development of Asiatic Russia. One well-established fact about existent railway, steamboat, industrial, or educational progress, he evidently considers, is worth reams of discussion of obsolete conditions. On this side of his work he has evidently drawn upon that invaluable work, the official 'Guide to the Siberian Railway;' just as in the historical chapters he owes not a little to Vladimir's 'Russia on the Pacific,' the best handbook yet published in the English language on the Slav conquest of North Asia.

In a treatise of such distinct merit it seems almost ungracious to notice defects. But it is unfortunately true that the reader is often harassed by the too frequent obscurity, carelessness, and ambiguity of the style, and that strange inaccuracies or inconsistencies are to be found here and there. Thus, Bering the "German," whose Danish nationality is elsewhere admitted (p. 147), Mithridates, the "great leader of the Parthian empire" (p. 271), the "celebrated Kara-Kitai . . . who had established *his* capital at Kulja" (p. 368), are puzzling; nor can we altogether grasp the "orthodox" Mohammedans of the Caucasus, as distinguished from Sunnites (p. 345). The author does not seem to be aware that the railway between Tashkent and Orenburg has for some time been in active construction (see p. 449), or that the Baikal-Kalgan railway project, over the Gobi, has been, for the time at least, abandoned in favour of the branch along the west slope of the Great Khingan range connecting the North Manchurian line with the Great Wall. Once more, he seems to write as if Timur's empire for years extended up to the walls of Constantinople and the banks of the Ganges (p. 371); he is rather loose in his references to eighteenth-century Russian history; and his spelling of names is occasionally inconsistent (*e.g.* Yana on p. 86, Jana on p. 87). But these and similar matters do not impair the general value of a most conscientious and useful study, marked in every part by an admirable candour and an open-minded spirit of inquiry.

C. Raymond Beazley.

Siberia and Manchuria.

'The Real Siberia, together with an Account of a Dash through Manchuria.' By John Foster Fraser. London: Cassell & Co. 1902.

This is a short, unpretentious, but first-hand record of a journey across the entire length of North Asia by the Siberian-Manchurian railway; it is also a record of the observations of an intelligent and practical man, who fairly claims for

his book that, whatever its faults, it is the honest work of a man who went out to see, and has written about what he saw.

The result of Mr. Fraser's inquiries was to show that the popular, or rather the old, ideas about Siberia were altogether wrong. For here was a land of immense agricultural possibilities, great stretches of prairie waiting for the plough, huge forests, magnificent waterways, and rising towns—a country that recalled Canada and the best parts of Western America. The author has called his book 'The Real Siberia,' because in it he has tried to show that the Siberia of convicts and prisons is passing away, and the Siberia of the railway, the reaping-machine, the gold-drill, the new town, is awakening into life. He was one of the first Europeans—not a Russian—to cross Manchuria by the new railway, though he did not traverse the southern branch from Port Arthur to Kharbin, and the account of his transit is both interesting and valuable as a faithful account of the exact state of the "Chinese Eastern Railway" in the autumn of 1901. Occasionally Mr. Fraser makes mistakes or performs strange feats with Russian words—*cechas* (for *seichas*) on pp. 56, 57 may be mentioned, where the form represents neither the letters nor the sound—but as a whole 'The Real Siberia' may be emphatically commended. Its atmosphere is throughout one of reality and truth.

C. R. B.

'Durch die Mandschurei und Sibirien.' Reisen und Studien von Rudolf Zabel. mit 146 Abbildungen zumeist nach photographischen Aufnahmen des Verfassers. Leipzig: Georg Wigand. 1902.

This is one of the most thoughtful and valuable works we have had lately on East Asia—for with East Asia it is essentially concerned. The lands west of Baikal are only touched on in the last twenty pages (291–311, *Im "train de luxe"*), while all the remaining space is given to Pechili, Manchuria, the Maritime Province (Vladivostok, etc.), the Amur, and the Trans-Baikal region. The author first takes us from Pekin to Shan-hai-Kwan and the eastern end of the Great Wall, then through south-western Manchuria to Niuchwang, where he stops to describe how Manchuria became Russian, and what precisely was the state of Russian control and administration in the occupied provinces when he passed through (January to June, 1901). Dr. Zabel then visits the Russian leasehold in Southern Manchuria, describes Port Arthur and Dalnii in the Liao-tung peninsula, the future Gibraltar and San Francisco of East Asia, and discusses the treaty obligations undertaken by the Russian Government in respect to Manchuria (Part i., pp. 3–90).

In the second part of his book the writer details a wearisome stay at Vladivostok (*Leben und Treiben am Goldenen Horn*), and gives a fascinating sketch of a whaling voyage off the Siberian coast; next follows the journey by the Ussuri railway from Vladivostok to Khabarovsk; we are then given an historical sketch of Russia's advance from the Urals to the Pacific; and finally we are brought back to Europe, by steamer up the Amur between Khabarovsk and Stretensk, by rail through the Trans-Baikal to the Holy sea, over the Baikal in steamer once more, and home from Irkutsk by the Siberian express.

Two special features may be noticed in Dr. Zabel's work: first, the admirable series of illustrations, chosen with independence and judgment, often giving novel and striking pictures even of the best-known things and places, and always well finished; second, the philosophic and historical character of certain chapters and of many passages of other chapters. The original diary form is preserved throughout, and a very clear, animated, and amusing style is employed. Among the parts which seemed to add most conspicuously to older works we may instance—the account of Port Arthur and Dalnii, and of the measures taken to realize a great

military and commercial future for the new Russian ice-free ports, in connection with which an instructive official plan of the projected town on Talienwan bay is given on p. 75; the description of the town, and especially of the Museum, of Khabarovsk, and its ethnological, biological, anthropological, and other collections; and the description of Vladivostok. On the other hand, the author has perhaps not given quite enough space and attention to Blagoveshchensk; and though one is grateful for the excellent letterpress on Port Arthur (pp. 64–72), its value would have been much enhanced by some views of the place. Economical and political reflections of no small value are to be found in almost every part of Dr. Zabel's book; in particular we may notice the concluding estimate of the Siberian railway on pp. 300–307. A select bibliography, useful, but omitting some of the most important recent studies of Siberia (*e.g.* those of Cotteau and Henry Norman), concludes the volume. C. R. B.

'The Great Siberian Railway.' By M. M. Shoemaker. New York and London, 1903. G. P. Putnam's Sons. Pp. viii., 236.

This is a record of a journey taken over the North Asiatic trunk line in the spring of 1902. It is a very condensed, note-book sort of a record, which everywhere shows an open and active intelligence, anxious to understand, to view things from an inside rather than an outside standpoint, but too careless, too much in a hurry, to produce a thoroughly satisfactory result. Distortions of names and inconsistencies of statement are constantly met with. Thus on p. 33 we have "Zalatouse" for Zlato-ust, the so-called "Golden-Mouth" town of the Urals. On p. 140 we are told that Mukden, in Manchuria, has 20,000 people; on p. 165 the same place is credited with 200,000. Two places are made into one in the strange compound Bitsy-yo-Tsin-chzou; elsewhere these two cities of the Liao-tung peninsula are distinguished (see pp. 126 and 136). The forms "Czar" and "Tsar," "Dalni" and "Dalney," "Chiliabinsk" and "Cheliabinsk" are used interchangeably, and almost with the freedom of an Early English book, where one never knows in what strange form an old friend will be next disguised. Again, while at Tomsk the author records, as the only historical event worth notice, the exile of Catherine Dolgoruky, he is silent as to Theodore Kuzmich, the monk, and says nothing of the local tradition that under this name lived and died the Emperor Alexander I. after his disappearance from the world at Taganrog. Lastly, both in praise and blame Mr. Shoemaker is hard to follow. On the one hand, we are told that Russia can accomplish more and in less time than any other nation (p. 59); on the other, no improvement is said to be discernible in the general information or intelligence of the people during the last twenty years. As usual, the truth lies between these extremes: Russia does not perform better and quicker work for civilization than other great nations; but it is idle to pretend that she does not accomplish a good deal. Her field of action is so vast that any progress at all among her people affects an immense area, both of space and race. Considering the backwardness of her development, she has of late advanced as rapidly as any country; and in education the percentage of "literates" has risen from 11 to over 25 per cent. in the last twenty years. But when all criticism has been made, it remains true that the general reader will find much in these pages to interest and inform him, especially in the copious extracts which the author gives from that primary source of reliable knowledge as to present-day Siberia, the 'Guide to the Great Siberian Railway,' published by the Ministry of Ways and Communications. C. R. B.

Sakhalin.

'Un Bagne Russe' ('Ile de Sakaline'). By Paul Labbé. Paris: Hachette. 1903. Pp. 272.

This work consists of three parts—a study of the criminal transportation and colonization in the Russian Botany Bay of the Far East; an account of the mines and fisheries of the island, and especially of the latter as affecting Japanese interests and the diplomatic questions at issue between Russia and Japan; lastly, an elaborate description of the decaying native races of Sakhalin. In the first, M. Labbé, in sharp contrast to Mr. de Windt, criticizes and condemns with severity, though from his indictment it is apparent that certain important ameliorations have been gradually effected in recent years. In the second part an interesting parallel to the French shore question in Newfoundland is discussed, and the extreme importance to Japan of the Sakhalin fisheries is shown. "'Grace à la question des harengs, nous avons barre sur les Japonais' me disait un diplomate russe." At the same time it is contended that Russia will be only too glad to allow the Japanese to fish in Sakhalin waters, in return for a friendly neutrality as to Manchuria. In the third part, by far the most interesting and elaborate, the author makes a contribution of distinct value to our knowledge of the fast-dying aborigines of North Asia—Tunguses, Giliaks, Oroks, Ainus—and gives us a detailed account, from a long and close personal observation, of their manners and customs, occupations and modes of life, beliefs and superstitions, legends, songs, funeral and marriage ceremonies, and festivals. Especially is that festival depicted which centres round the sacrifice of the bear, that symbolic animal "stronger than a beast and wiser than a man" in whom Kirghiz, Mongols, and Tunguses alike recognize a supernatural power.

C. R. B.

AFRICA.

Morocco.

'Voyages au Maroc (1899–1901).' By the Marquis de Segonzac. Paris: Colin. 1903.

Of recent travellers in Morocco, none perhaps has done more to increase our knowledge of the country by itineraries through the little-known districts than the Marquis de Legonzac, a young and ardent explorer who, between 1899 and 1901, carried out a number of venturesome journeys in the guise of a Mohammedan sometimes passing for a mendicant, at others for the servant of an influential sheriff, and yet again as a pilgrim visiting the sacred places of the country. It will be readily understood that, journeying under these circumstances, it was no easy task to bring back a harvest of scientific results. Such, however, was M. de Segonzac's enthusiasm for his self-imposed task, that he triumphed over all obstacles, and the material which he secured in the form of route-surveys, astronomical observations, ethnological notes, botanical and geological collections, forms, as already stated, an important contribution to our exact knowledge of the interesting country on which so much attention is just now focussed.

M. de Segonzac's explorations had to do principally with three distinct regions, and we may glance at their principal results for each of these in turn. The first is the Rif—that home of turbulent tribesmen—into the interior of which hardly a European had previously penetrated, though its geographical features had been to some extent revealed by the painstaking study of native information undertaken some fifty years back by Captain Beaudoin, whose conclusions are in the main strikingly confirmed by his countryman's labours. M. de Segonzac twice crossed the whole breadth of the Rif country, first making his way from Fez to Melilla on the coast, and afterwards returning from the bay of Alhucemas to Fez by a route

parallel to the former. His observations show that the Rif mountain massif consists of a series of ridges forming concentric arcs parallel to the coast-line between the Straits of Gibraltar and Cape Tres Forcas. The orographic core or centre of the region lies in about 34° 45′ N., between 3° 55′ and 4° 10′ W. of Greenwich. Among other results of these journeys is the means they supply of elucidating the travels of Roland Frejus in 1666, the only traveller who penetrated the Rif until recent years.

The second main division of the country on which new light has been thrown by M. de Segonzac is that of the so-called Middle Atlas, and of the upper Muluya valley to its south. Here his routes differed considerably from those of his predecessors—Rohlfs, De Breuille, De Foucauld, and others—and besides crossing the range twice, towards its eastern and western extremities, he penetrated to its main ridge from the north at about its centre, on the upper waters of the Sbu. South of the Mulaya valley he likewise attacked the chain of the Great Atlas, and effected the ascent of Jebel Aiashi, which he found to reach a height of 4250 metres, or almost 14,000 feet, the height which has generally been assigned to it. The Middle Atlas is described as formed by three chains which fall in terraces to the Sbu basin on the north. The principal chain is the southernmost, which falls some 9000 feet to the Muluya valley on the south, and culminates in the Jebel Mussa, 13,000 feet above sea-level. The third district traversed by the author lay at almost the opposite extremity of the kingdom, in the extreme south-west, where, though his routes were not to the same extent new, he did good work in giving greater precision to the map. His observations confirm satisfactorily the results of Joseph Thomson (as against the map of M. de la Martinière), as regards the position of the Bibawan pass over the Great Atlas, and its *rôle* in relation to the systems of the Tensift and Sus. Some new routes were also surveyed in the basin of the latter river, and in the Sahel region to the south.

Only the first two-thirds of the volume are occupied with the author's personal narrative, which embodies many interesting details on the country and its inhabitants, the remainder consisting of reports by specialists on the ethnological, meteorological, geological, and other scientific material brought home. Of 130 species of plants represented in M. de Segonzac's collection, twenty-seven are new to science as coming from Morocco, though found in other parts of the Mediterranean region. An excellent summary of the geographical results is supplied by M. de Flotte Roquevaire.

The Congo State.

New Africa. An Essay on Government Civilization in New Countries, and on the Foundation, Organization, and Administration of the Congo Free State.' By E. Descamps. Translated from the French. London: Sampson Low. 1903.

This book, whose author is Professor of International Law at the University of Louvain, is, in spite of its somewhat misleading title, virtually a presentment of the case for the Congo State in the controversy which is now engaging so much attention, and a favourable bias on the part of the writer is manifest at every page. Still, the book should certainly be read by all who wish to examine both sides before reaching a final conclusion on the subject. The services rendered by King Leopold and his coadjutors towards the opening up of a previously sealed region are put forward with much skill, while the reverse of the picture is as far as possible concealed, the abuses which it is allowed may exist here and there being treated as incidents not affecting the general issue. The writer criticizes the false views (as he takes them to be) prevalent respecting the international status of the state, showing—and with justice—that the Berlin Act was in no way responsible for its

calling into being as an independent sovereignty. But like all the apologists, and not a few even of the critics, of the state's policy, he seems to overlook an important consideration, viz. that the claim of the state to nearly a million square miles of territory, including some of the most fertile and densely peopled regions of Africa, could never have been allowed by the European Powers, several of whom had prior interests in the region, except on the consideration of the philanthropic and international character of the enterprise; and that this fact places the state in an entirely special position among the ranks of sovereign powers.

As is but natural considering the standpoint of the writer, the part played by King Leopold in the modern awakening of Africa is greatly magnified. Many will, however, think that, if the merit belongs in reality to any one man, that man can be no other than David Livingstone.

The Niger.

'Le Niger: Voie ouverte à notre Empire Africain.' Par Capitaine Lenfant. Paris Hachette. 1903. Pp. vii., 252.

The primary object of Captain Lenfant's work, and of the record of that work which the present volume contains, is to show that the rapids of the lower Niger can be ascended or descended with sufficient ease and frequency for the purpose of maintaining constant communication by water between the upper river and the sea. In this enterprise the pioneers had been Lieut. Hourst and Captain Toutée, of whom the former had denied, and the latter had stoutly affirmed, the normal practicability of this fluvial route between Bussa and Say. Lenfant's experience fully confirmed the optimistic views of Toutée.

On February 21, 1901, a fleet of twenty boats under his command, plentifully stocked with supplies of all kinds, began the ascent of the Niger at its mouth, and on May 25 that same fleet, uninjured and with all its stores, arrived at Say; on May 29 it reached Niané, the Niger terminus of the direct route from Zinder and Lake Chad. On this voyage the two enclaves leased to France upon the lower Niger in the treaty of 1898—the "Enclave Toutée" in the Delta, on the Forcados channel, and the "Enclave d'Arenberg," just below the last rapids, and opposite Bajibo—were visited and used as bases of supply and reinforcement. Captain Lenfant makes an elaborate study of the hydrography of the Niger basin, the causes and extent of the annual floods, and the differences between the upper, middle, and lower river; for these three sections he uses the well-known terms of Joliba, Issa-ber, and Kwarra respectively. While naturally proud of his achievement, and an ardent exponent of this line of communication between the sea and the inner regions of the French empire in North-West Africa, the author does not conceal his conviction that the projected railway from the Dahome coast to Say (already completed as far as Abome) is the only satisfactory and final solution of the problem, the only adequate link between the middle Niger countries and the French African littoral. In the future of cotton-culture in the Western Sudan Captain Lenfant is a confident believer, and he devotes some of his most suggestive pages to an explanation of the best methods to be taken for ensuring the proper development of native industry. Miss Kingsley was fond of saying that the remarkable African dominion built up by the Third Republic had, along with many merits, one chief defect—a lack of commercial intelligence. But of late there have been many signs—and this book is one of them—that Frenchmen are awakening to the commercial possibilities of "France noire." C. R. B.

Nigeria.

'Letters from Nigeria of the Honourable David Wynford Carnegie, 1899-1900.' Privately printed. Brechin: Black & Johnstone. 1902.

The letters here printed were written to friends at home by the promising young Nigerian official, whose untimely death in the performance of his duty has been so deeply lamented by all who knew him and could duly appreciate his many fine qualities. They present a vivid picture of the everyday life of the European in the African wilds, and the fight against adverse circumstances which has to be waged by those who bear conscientiously (as did David Carnegie) "the white man's burden" in those fever-haunted regions. But apart from their pathetic personal interest, they contain many graphic touches, helping to a comprehension of the nature of the country, the life of its inhabitants, and their relation to the white man who dwells among them, which show that, had he been spared, their author would have been a trustworthy instructor of the public at home on West African affairs, no less than a capable actor amid the scenes described. His exceptional talent for dealing with native races, and his kindly feeling towards them, are constantly brought out, and the glimpses of his personal character which they supply enhance the regret at his sad and untimely fate.

AMERICA.

The Sierra Nevada.

'Mountaineering in the Sierra Nevada.' By Clarence King. London: Unwin. 1903.

We welcome this reprint of a work which must always remain a classic in geographical literature, but which, owing to the fact that it has long been out of print and therefore comparatively inaccessible, is perhaps not so widely known to the present generation as it deserves to be. It possesses the twofold attraction of being written by a man of science, capable of drawing the proper lessons from the facts observed, who is at the same time keenly alive to the glories of external nature, and appeals to the imagination of his readers in his descriptions of the western forests and snowy mountains with a skill which has rarely been equalled; while the insight incidentally conveyed into his own personality is not the least of its charms. The book is well got up, and though it may be thought by some that its attractiveness would have been enhanced by illustrations of the striking natural scenery first explored by Mr. King and his companions, it is no doubt more satisfactory on the whole that the book should remain as it left its author's hands. It is, we repeat, one which should find a place in every geographical library, no matter of how modest extent.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Evolution of Botanical Geography.

'Botanische Forschungen des Alexanderzuges.' Von Dr. Hugo Bretzl. Leipzig: Teubner. 1903.

During his daring expedition for the conquest of India, Alexander the Great was accompanied by a staff of officers who not only looked after military operations, but who in part were told off to make observations of scientific interest when visiting places which were new to the Greeks, and India, of course, was to the Greeks a quite new world. The records of these scientific observations made by the members of Alexander's military staff during their stay in India and their return journey were deposited in the imperial archives of Babylon. These were

unfortunately destroyed later on, but not before they had been made use of extensively by Theophrastus when writing his 'Stories of the Plants.' Alexander the Great was the first to collect scientifically material for a treatise on the distribution of plants; Theophrastus was the first to write a memoir on this subject.

In the book now under review, Dr. Bretzl has succeeded in giving the reader a very good idea of what the Greeks observed and noticed on their expedition to India. By quoting freely from the Greek text of Theophrastus, and by frequent reference to modern books, he has been able to establish the marvellous accuracy of the observations made by Alexander's officers, and the scientific value of the memoir which Theophrastus based on those observations. Though essentially botanical, the book before us should appeal equally in the first place to the geographer, the botanist, and the classical student, but in the second place to anybody who can appreciate the first dawning of an important branch of natural science—namely, the geographical distribution of plants. Dr. Bretzl's book contains many chapters which are hardly of sufficient general interest to be referred to here, but one or two are worthy of more detailed notice. These will serve to show the character of the whole book.

The mangrove forests, which the Greeks first saw from their ships, have been most carefully described by Theophrastus by the aid of the material supplied by the Greek officers; and from the Greek text of his work, Dr. Bretzl is able to make out the chief components of the mangrove forest in the Persian gulf—the large trees of *Avicennia officinalis* with their greyish leaves form the dense inner part, *Rhizophora mucronata* with its green leaves the marginal portion of the forest. This observation is new to botanists, as far as the Persian gulf is concerned, but is circumstantially confirmed by researches into the mangrove of the Red sea. *Rhizophora mucronata* has been so well described by the Greeks as to make it possible to determine exactly the months during which the Greeks visited the mangrove swamps. They saw the flowers in November, and the mature fruit in December and January, but they did not observe the peculiar viviparous germination of the seed. This interesting phenomenon was first recorded by the Arabs.

Theophrastus comes to the conclusion that the brackish water favours the growth of the larger *Avicennia*, whereas the smaller *Rhizophora* prefers the pure salt water of the sea. This view is also held by Dr. G. Karsten, and it shows that Theophrastus was already hunting after a physiological reason for the geographical distribution of plants.

Schimper does not record the occurrence of mangrove forest along the shores of the Persian gulf, nor does he admit that west of the mouth of the Indus any other plant but *Avicennia* is found as the chief constituent of the mangrove forests. On reference to Theophrastus, we find that the Greeks carefully noted the presence of the mangrove forest in the Persian gulf. From their descriptions, furthermore, it is clear that *Rhizophora mucronata*, in addition to *Avicennia*, formed part of the swamp vegetation; thus we are able to glean new facts from observations made two thousand years ago. This distribution of the Mangrove in the Persian gulf, as mentioned by Theophrastus, receives ample confirmation on reference to the excellent British Admiralty charts. The mangrove forests observed along Clarence strait and along the north-eastern coast of Bahrein island were carefully examined by Alexander's officers. These old observations are compared by Dr. Bretzl with modern researches, and in the end the reader gets a very clear idea of these remarkable marine forests, and their distribution and history.

The history of the banyan tree, *Ficus bengalensis*, is well recorded by Theophrastus; he even discusses the morphological nature of the props as root-structures. But he has come to grief over the description of the leaves, which evidently belong to *Musa sapientium*, and not to *Ficus bengalensis*.

The Greeks not only made careful observations when away from home, but they also studied their own flora. It was due chiefly to this that they were able to notice and appreciate the many remarkable plants they came across on their journeys. Thus very early they separated geographically the sunny and dry continent of Asia (including Africa) from the moist and cold Europe. Theophrastus was able to confirm this view from his own observations. *Abies pectinata*, a fir, he found to be an exclusively European tree, not occurring in Asia, except along the coast of Asia Minor, which, however, he considered to have the same climate as Greece and the other parts of Europe.

The date-palm was correctly taken as the typical plant of the sub-tropical desert zone of Asia, the fir and ivy as two types characteristic of the Central European forest zone. This view was held by the Greeks till they came to the Himalayan hills. The four typical coniferous trees of the Himalayan forest mentioned by Schimper are also noticed by the Greeks, namely, *Abies Webbiana* and *Smithiana*, *Cedrus deodora*, and *Pinus excelsa*. The latter occurs also in Macedonia. The Greeks ascended the hills of the Himalayan range more than 2100 metres in search of wood for building ships, by which to return to Greece. The vegetation noticed between 900 metres and 2100 metres struck the Greeks as being remarkably similar to the vegetation of the lowlying plains of their native country. Both regions are characterized by sclerophytes (plants with hard leaves). Beyond the 2100 metres they got the forest; they were thus able to observe the regional division of the vegetation on the mountain-side, the higher regions of a tropical mountain being generally temperate in character. The Greeks were very much surprised to find coniferous trees so far away from home, and this discovery should have put an end to their theory that the conifers were exclusively European plants.

The Greeks returned home from India partly by sea and partly by land. The overland route led them through Baluchistan, where they fully appreciated the ever-dry sandhills and the generally dry wadis, which are, however, occasionally flooded during a heavy downpour of rain. The land journey also showed them that there was no connection between the needle-leaved forests of the Himalaya and Macedonia. For this reason—not perhaps very logically—they continued to uphold their view that the fir was essentially a European tree. Theophrastus had already come across one exception, namely, a forest in Armenia, which has since been admirably described by Radde. Theophrastus has made mistakes here and there, but in separating *his* Europe from *his* Asia, he was practically preparing the way for the separation of what we to-day call the Central European forest region.

Eratosthenes was the first to see that Europe and Asia could not be separated by a north-to-south line on geobotanical evidence. A line should be drawn from east to west to separate a northern from a southern district. This view, which makes the fir woods of Macedonia and the Himalaya not widely separate groups, but merely southerly outrunners of the large northern forest, has received ample confirmation from modern geobotanical research.

The attempt has been made to give, in a few words, some idea of the scope of Dr. Bretzl's book, which is a most valuable and interesting publication. It should make fascinating reading for all those who take an interest in geography in its widest sense.

O. V. Darbishire.

GENERAL.

Mountaineering.

'Hochtouren in den Alpen, Spanien, Nordafrika, Kalifornien und Mexiko.' Von Raimund Schäfer. Leipzig: J. J. Weber. 1903.

Dr. Schäfer is an ardent climber and a geologist as well as a doctor of medicine. His volume is very various in its contents. In the early chapters he recounts his alpine adventures, which include a night in the observatory on the summit of Mont Blanc. These are followed by some tourist's notes on Spain, and a glimpse at Morocco. The reader is then called on to leap the Atlantic, cross by the Canadian Pacific Railway to San Francisco, and return by Mexico. To the geographer the most interesting portion of the volume will be the account of the great Mexican volcanoes. Dr. Schäfer climbed Popocatepetl, Orizaba, and Ixtaccihuatl, and gives interesting details as to their features and geology. He calls attention to the unequal melting of the snowfields under tropical skies which produce the conditions known in the Andes as "Nieves penitentes," a term the origin of which Dr. Schäfer misapprehends. Sir M. Conway's observations* do not seem to have been taken account of in the explanation he offers of the phenomenon. The volume is well got up, and fully illustrated; some of the coloured plates from the author's sketches being exceptionally successful.

THE MONTHLY RECORD.

THE SOCIETY.

French Geographers at the R.G.S.—An excursion to this country having been arranged in connection with the Annual Congress of French Geographical Societies, held this year at Rouen, an invitation was sent by the Society to the members of the party to a luncheon to be held in their honour during the course of the visit. It was at once accepted, and Monday, August 10, fixed for the date of the reception. On that day a party of some ninety members of the Congress, including several ladies, arrived at the Society's house at 11.30 a.m., and was received, in the absence in Norway of the President, by Major Darwin and other members of the Society's Council and staff. Among the distinguished visitors were M. Zévort, rector of the Caen Academy and president of the Congress; M. Canonville Delys, president of the *Société Normande de Géographie;* Generals Guillet and Messonier; M. de Saint Arroman, representing the Ministry of Public Instruction; M. Monbrun, representing the Geographical Society of Oran and the Government of Algeria; M. Monflier, general secretary of the Congress; and M. Sarrazin, the historian of Normandy. After examining the various objects of interest at the Society's house, including manuscript maps by explorers, early editions of Ptolemy, and other old geographical works which had been laid out for their inspection, the visitors proceeded at 12.30 to lunch at Limmer's Hotel, where the chair was taken by Major

* 'Aconcagua and Tierra del Fuego,' pp. 55 *et seqq.* Reference may also be made to Dr. Hauthal's paper in the *Revista del Museo de la Plata*, vol. x. (1902).

Darwin, who expressed regret at the inevitable absence of the President. The other representatives of the Council included Lord Belhaven and Stenton, Mr. E. L. S. Cocks, Colonel J. K. Trotter, Colonel C. M. Watson, Captain D. Wilson-Barker, and Mr. D. G. Hogarth. The chairman, in proposing in French the toast of "His Majesty King Edward VII.," alluded to the services recently rendered by the King as a messenger of good-will between the two nations; and the toast was drunk with great enthusiasm, as was also the second toast, that of "M. Loubet, the President of the French Republic." In proposing the toast of the French Geographical Societies, in terms which again elicited a warm demonstration of good-will on the part of the company, Major Darwin spoke of the good work done throughout the world, largely under the inspiration of the oldest French society, that of Paris, by French travellers, mentioning in particular the names of Dumont d'Urville, who was exploring the southern polar seas at the time of the English expedition under Sir James Ross; Lieut. Bellot, who lost his life as a volunteer on one of the Franklin search expeditions; and the Gold Medallists of the Society, MM. Garnier, Reclus, Binger, and Foureau. In replying to the toast, M. Zévort expressed the thanks of the members of the Congress for their cordial reception by the Royal Geographical Society, alluding to the enhanced pleasure derived from the fact that they had been received by a son of Charles Darwin. MM. Vial and Canonville Delys having also spoken, M. Monbrun (of Oran) proposed a toast to the closer union of the British, French, and African geographical societies, remarking that the society which he represented was the oldest representative of the last category. In conclusion, M. Sarrazin made a courteous allusion to the services rendered to the Congress by the British delegates, Mr. H. J. Mackinder and Mr. J. P. Thomson.

EUROPE.

Basins of Subterranean Drainage in the Swiss Alps.—Messrs. Lugeon, Ricklin, and Perriraz have presented a note to the French Académie des Sciences (*Comptes Rendus*, cxxxvi., No. 18, May 4, 1903), on the areas drained by rivers which disappear underground as measured on the 1 : 25,000 or 1 : 50,000 Siegfried sheets. The following is a summary of the results:—

	Depressions.	Hectares.	Acres.
Pre-Alps, left bank of Rhône	8	1,088·3	2,689·2
Marginal zone of Pre-Alps (between Rhône and Aar)	2	24·6	60·8
Middle zone of Pre-Alps (between Rhône and Aar)	46	4,123·0	10,188·6
Internal „ „ „ „	16	727·7	1,798·3
High Alps, limestone, Savoy to Aar	28	11,067·8	27,350·1
„ „ Aar to Reuss	21	3,439·1	8,498·5
„ „ Reuss to Rhine	65	17,189·4	42,477·4
Alps of Valais, south of Rhône	11	358·5	885·9
„ Ticino	8	642·7	1,588·2
„ Grisons, south of Rhine	31	3,516·6	8,690·0
Total	236	42,177·7	104,227·4

The majority of these closed basins are in the limestone, which is Upper Jurassic in the Pre-Alps, Urgonian in the outer, and Malm in the inner regions of the High Alps. They are rare and unevenly distributed in the crystalline Alps, mainly where limestone occurs, while they are uncommon on the Flysch and absent in the folded molasse. The majority are near lines of faulting, and it is remarkable that high parts, such as the Wildhorn, Wildstrubel, and Zilbern, loose their melted snow by sinkholes, and so may be compared to pierced roofs. Few are found near the great valleys. Most possess little lakes of variable level, *e.g.* Lake Tancy, Daubensee, Glattensee, Obersee of the Glarner Alps.

Weather and Bird-migrations in Hungary.—The influence of weather conditions on the arrival in Hungary, in spring, of migratory species of birds, has been studied for some years by J. Hegyfoky, who summarizes the results of his observations in the *Meteorologische Zeitschrift* for February of this year. With regard to the arrival of swallows, he has found that the mean date of arrival is April 5, the isotherm for which day is 9°·4 C. (53° Fahr.), which agrees well with the facts observed with regard to the temperature of the mean date of arrival at eighteen different stations in Europe. A retardation of 3·03 days was observed for 100 metres' increase of altitude, while only 1·17 days' retardation seems occasioned by 1° difference in latitude. For a proper comparison of the arrival of birds with the weather conditions, it is not sufficient to know the mean date of arrival, and Herr Hegefoky therefore attempted a comparison of the whole course of the phenomenon with the corresponding weather conditions. He found that in six different years the period of five days in which the arrival of swallows culminated was one of low barometric pressure. This fact was most clearly marked in 1898 and 1899, in which years the greatest number of observations were taken, it being found that during a period of low pressure which prevailed from March 25 to April 2, 1898, 51·5 per cent. of the total arrivals were recorded, and during a similar period in 1899, from April 8 to April 16, 44·2 per cent. Much was found to depend on the direction from which the depression advanced, for its influence was so much the greater when its favourable side was turned towards Hungary, and mild weather with south, south-west, or south-east winds prevailed. These conclusions were also borne out by observations of the arrival of the cuckoo and other species. Dividing the country into four main subdivisions—the great plain, the western region, with a small amount of lowland, the eastern mountains, and the northern mountains—the writer finds that the birds arrive first at stations in the first-named, an average retardation of 5·1 days being observed for the western region, 6·1 days for the eastern, and 10·5 for the northern. These facts are again explained by the climatic conditions. Other observations show that the species which arrive early show a larger amount of variation in the date of arrival than those which arrive later, and this is of course due to the greater variations in the weather conditions in the earlier period.

New Triangulation in Iceland.—The old triangulation of the coast of Iceland, executed by Major Scheel in 1801–15, has been found to be very defective, and in 1900 Captain Hammer reported that it was impossible to base a marine survey on the old triangulation between Reykjavik and the Hornafjord. It appears from the old map that the surveyors, owing to the difficulties of the country, were not always able to complete the network, as between Ingolfshöfdhi and Klifatindr, about 60 miles distant, which they had to connect by a polygon, and that some angles at the stations could not be measured. Calculations of the line Stadhfjall—Ingolfshöfdhi from the net eastwards from Akranesskagen and by the southern series, resulted in a difference of about 70 yards. Accordingly, in the summer of 1902, an expedition was sent from Denmark to execute a new triangulation along

the southern coast, which was divided into two parties, one under Captain Lund-Larssen proceeding to Hornafjord, and the other working eastwards from Reykjavik. The former measured a base 5501·178 yards long on a landspit at the mouth of Hornafjord, from which they carried a network of triangles westwards, establishing stations on the steep lofty summits of Thverártindsegg and Bakkatindra, and including the islands Hrollangseyjar and Tvisker in the survey. Being favoured by calm, bright weather, they were able to land and take observations on the Hrollangseyjar. This network was extended westwards to Kaldbakur and Fossnûpr, and the Reykjavik party, which had fewer difficulties to contend with, pushed its triangulation to Seljaland, east of Markarfljót. The work was satisfactorily carried out, and the results will no doubt be at least accurate enough for all practical purposes—*Geografisk Tidskrift*, 17^de^ Bind, Hefte i.–ii.

ASIA.

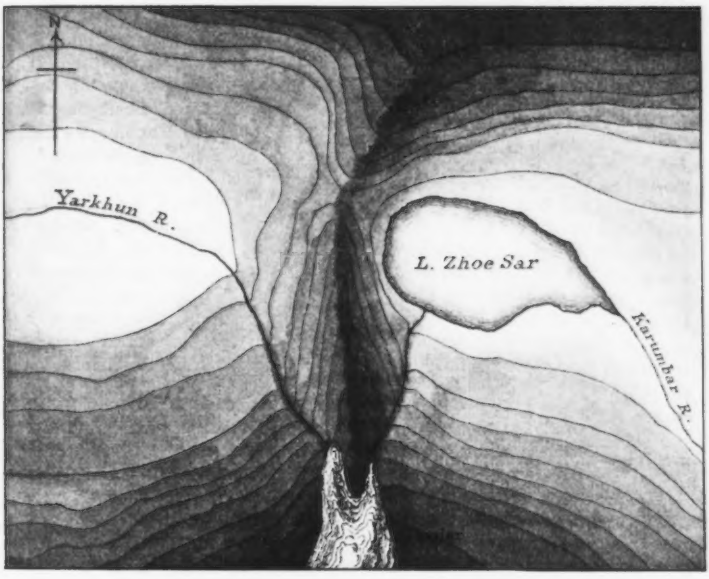
The Restoration of the Ancient Irrigation Works on the Tigris.—Since his retirement from the superintendence of the Egyptian reservoirs, Sir William Willcocks has been surveying the remains of the old irrigation works in the Tigris-Euphrates basin, in order to ascertain how far it might be possible to repeat in the Mesopotamian lands the engineering operations which have been attended with such signal success in the Nile valley. He has embodied his views on the subject in a paper read before the Khedivial Geographical Society, Cairo, on March 25 of the present year, and since printed as a pamphlet. His studies on the spot were greatly facilitated by the previous surveys of Commander Felix Jones, to whom all due acknowledgments are made, and whose two large maps of the Nahrwán canal and of the Tigris north of Baghdad (1849–50) are here reproduced, together with ten plates of illustrations. The now roughly completed surveys of the remains of reservoirs, dams, bridges, and regulators between Dura and Babylon show that there were formerly three distinct irrigation systems—one on the left, another on the right bank of the Tigris, and a third connecting that river with the Euphrates on the plains of Shinar. Near Opis (later Antiochia) at the head of its inland delta, the Tigris is joined by the Atheim (Physcus), on the left, and lower down by the Dyala (Delas), just above Baghdad. Here were developed the two systems of the Tigris proper, that of the Nahrwán canal on the left, and the Dijeil on the right bank. The Nahrwán, the largest canal ever constructed out of China, had its original head at Dura, about midway between Nineveh and Babylon, where the intake is still marked by the massive ruins of Kantereh-Resareh. From this point it was carried southwards for 240 miles along the left bank of the main stream, feeding all the secondary canals drawn from the Atheim and the Dyala, and supplying abundance of water to many hundred thousand acres of rich alluvial lands. In the section between the 100th and 120th mile, where Nausherwan's ruined palace forms a striking landmark, its banks are studded with ruined cities, and in some places this vast artificial artery was from 40 to 50 feet deep and over 360 feet wide. Its sudden ruin, caused by some unexplained diversion of the upper waters, brought about that utter desolation from which the middle Tigris region has never recovered. The second (Dijeil) system, though smaller, was still very extensive, and jointly with the first must have sufficed to irrigate nearly 2,000,000 acres of extremely fertile but now waste lands. When to these are added about 1,500,000 acres of the third (Tigris-Euphrates) system, we get a total of 2,800,000 acres which might be profitably reclaimed and cultivated, without including perhaps 3,000,000 acres lower down (about the Shatt-el-Arab), which have become too saline to be worth reclaiming at present. "Summing up the figures for upper Chaldea, or the lands of the [inland] delta of the Tigris, and for the swamped

lands of lower Chaldea between Babylon and Baghdad, we have a total area of 2,800,000 acres, and expenditure of £21,000,000 (for canalization, earthworks, and weirs), and a return of £60,000,000. These figures may seem large, but we are in one of the most famous tracts of the world, a tract whose past history justifies us in expecting that great results will follow if we bring to the solution of our problems the same wisdom the wise men of Chaldea brought to the problems of their day" (p. 25). The whole question is studied, not only on its merits from the purely agricultural standpoint, but also in connection with the proposed extension of the German Anatolian railway to the Persian gulf, and on this question Sir William has some shrewd remarks. "The Baghdad railway—that is what I have called the Mesopotamian section—will traverse these regions; its rails will be laid on the banks of a renewed and remodelled Nahrwán canal, and life and prosperity will again be seen in this land of great vicissitudes. Shall the canal be made with British capital coming from the west? Speaking financially, shall the canal be known as the Katul-il-Kaiser-i-Hind, or Katul-il-Kaiser-il-Almaigna; or, as of old, Katul-il-Kesrawia [the "Trench of the Kaisers"]? Labourers from India—British subjects—will dig the canals, construct the weirs and regulators, and then settle down in millions to reclaim and cultivate these lands potent with future wealth just as though they were in another Panjab. The through traffic between Europe and the East will be yielding no inconsiderable income, but when this traffic is supplemented by the transport of the abundant harvests of Chaldea, the Baghdad railway will be establishing itself as a financial success capable of satisfying the most sanguine of its promoters" (p. 32).

The Ancient Bed of the Oxus.—Prof. Bartold has made an interesting discovery relating to this vexed question, the details of which were fully discussed by Prince Kropotkin in vol. xii. of the *Journal*, p. 306. Hitherto no reliable notice has been found of the navigation of the lower course of the Amu-daria at the time when it flowed into the Caspian sea. Now, in the autumn of 1392 Timur conquered Mazanderan and sent its Seiid rulers to Kharezm (Khiva). According to Zakhir-ed-din-al-Merash, a historian of Taberistan who lived at the end of the fifteenth century, they were taken by boat from Sari to Ogurcha (an island off the east shore of the Caspian), and thence in boats up the Jihun (Amu). Here the author regards the disemboguement of the Amu into the Caspian as a well-known fact. Prof. Bartold holds that Abulfeda and other writers simply reproduced the statements of geographers of the tenth century and of Yakut, while Kazvin (fourteenth century) and Khafizi-Abru (early in fifteenth century) give independent testimony. The former states that several branches of the Jihun enter the lake of Kharezm, but that the main arm, passing through Kharezm, precipitates itself from the heights of Khulm, which in Turkish is called Yördeli (noise), for the roar can be heard to a distance of 2 or 3 *farsakh*, after which it falls into the Khazar (Caspian) sea at a place called Khalijan. From Kharezm to the sea it is six days' journey. Formerly flowing into the lake of Kharezm, it changed its course about the time the Mongols appeared in the country. Khafizi-Abru makes the same statement, saying that now—that is, in the year 820 (1417 of our era)—the Jihun had made itself an outlet to the Caspian, crossing the road from Khorasan to Bokhara. The Khojent (Sir-darya), he says, reaches Farab (a place on the Amu opposite Charjui), and, continuing on its course, unites with the Jihun in the Kharezm steppe. In an anonymous history written in 1582, in Turkish, for the sultan Murad III., it is said that God, being angry with the people of Kharezm, turned aside the Jihun from their capital, Urgench, and that it then flowed at some days' journey from the city.—*Zemlevedeniye*, 1902.

The Water-parting between the Chitral and Gilgit Rivers.—Major G.

Leslie, R.E., who has lately visited the sources of the Kunar or Chitral river, has finally solved the mystery of the Karumbar lake, which has hitherto been supposed to be the source of the Yarkhun (the main affluent of the Chitral river) flowing west, and of the Karumbar (an affluent of the Gilgit river) flowing east therefrom. As was proved in the case of the Oxus sources, the lake is not, strictly speaking, a source at all, but merely an incident in the course of the Karumbar stream flowing east, which has its real or ultimate source in a glacier which sits astride of the ridge dividing the Karumbar and Yarkhun valleys. Just as the glaciers and snow-fields astride of the Nicolas range supply all the main sources of the Oxus in the Pamirs by means of radiating and diverging streams, so does this glacier send down one tributary to the lake on the course of the Karumbar (the lake is locally known as Zhoe Sar), and another to the Yarkhun. The glacier, and not the lake, is thus



SOURCES OF THE YARKHUN AND KARUMBAR RIVERS.

the common origin or source of both streams. The accompanying map is based on a rough sketch sent home by Major Leslie.

AFRICA.

Egypt Fifty Years hence.—This is the title of an address delivered by Sir W. Willcocks to the Khedivial Geographical Society in March, 1902, which is printed as an appendix to the above-noticed paper (see p. 327) on the restoration of the Mesopotamian irrigation works. It deserved, perhaps, greater consideration at the author's hands, for, although of a somewhat speculative character, this flight into the future has a basis of solid fact, and in any case has a special value as the forecast of such a skilled observer. Taking his stand, so to say, on the barrage just constructed at Assuan on his own plans, Sir William looks up and down the great artery, and sees visions of ever-growing prosperity, not only in Egypt, the

land immediately benefited by that great work, but also in the whole region from the equatorial lakes to the Mediterranean. What, he asks, will the Nile valley look like fifty years hence? And he answers, "Green it will surely be; but it will be no longer a beacon pointing to the permanent prosperity which the irrigation systems of the ancient world could confer on a country. It will be a beacon showing what modern irrigation and modern science can do to develop agricultural wealth." Works will be carried out far beyond those of the Pharaohs of the twelfth dynasty, works which, in all human probability, will raise Egypt to a height of splendour and magnificence never witnessed even by the Ramses and Thotmes of the Middle Empire. A chief factor in developing the natural resources of the land to its utmost capacity will be the gradual transformation now going on of the old basin irrigation to a perennial system, to be effected by repeating the operations at Assuan on a greatly enlarged scale at all advantageous points in the direction of Khartum and the great lakes. Here will be constructed the vast reservoirs by which the upper Nile waters are to be husbanded and brought completely under control, and here will be settled the millions of industrious *fellahin* who "will have streamed southward into the peninsulas of Meroe and Sennaar, to begin there a new Egypt which may one day rival the old." Another element of prosperity will be the Suez Canal, a most valuable asset which reverts to the Egyptian Government in a few decades. Then, fifty years hence there will be communication by steam along the whole length of the Nile valley. By steamboat and by railway it will be possible to proceed from Alexandria and Port Said to Mombasa. The products of the Sudan will be finding an efficient outlet by means of the Khartum-Berber-Suakin railway. It may even be possible, by railway and by steamboat, to proceed to the Cape. In this latter case a colossal statue of Mr. Cecil Rhodes will greet the railway traveller as he passes the equator, just as Lesseps' statue greets him on entering the Suez Canal. The White Nile itself will undergo great changes, when the sudd and other obstructions are permanently removed, and its waters, now partly lost in the terrible swamps about the Sobat confluence, will flow over mighty weirs and dams, and down well-regulated channels. "From Lado to Khartum will be one unbroken stream, about 500 metres in width, of pure and wholesome water, with long rows of willows by the water's side on either bank. The sudd regions and the sudd marshes even, in great part, will have ceased to exist, and in their place will be the beginning of millions of acres of rice-fields and water-nuts." There is to be a huge regulating weir at Ripon falls, where the Nile leaves the Victoria Nyanza, and here, as well as at the Nile cataracts, will also spring up electric stations and factories for grinding plantain meal, one of the most nutritious and digestible foods in the world. At Tobongo, south of Wadelai, will be the great regulating weir, like those of Assiut and the Delta, but very much larger. "The amount of water held up will be 4 metres, and the width of the weir will be some 400 metres. It will be possible to discharge 2500 cubic metres per second at any time of the year. This quantity of water will suffice for the irrigation of 8,000,000 acres of cotton or sugar-cane in the valley of the Nile." It is to be hoped that no untoward complications may arise to disappoint the author's sanguine forecast.

The British East Africa Protectorate.—Sir Charles Eliot's recent report on the East Africa Protectorate (Africa, No. 6, 1903) is most interesting reading, and once more affords abundant evidence that in the Protectorate we have a possession which well deserves the attention of all interested in the development of the British Empire. The record of progress during the past year is, on the whole, thoroughly satisfactory, both as regards the material improvements introduced and the tendency displayed by the native inhabitants to accept the control of the white man and live peaceably under his administration. The policy

recommended by the High Commissioner of avoiding for the present a forward policy in the outlying provinces, and concentrating effort on those already more or less brought under control, seems thoroughly wise, for it is evident that the latter districts will supply work for the most energetic administration for some time to come. In the northern parts of the protectorate (Jubaland, etc.) the Somalis form a disturbing element, and without greatly improved communications the permanent settlement of Europeans among them, which would no doubt gradually change their attitude, is quite impracticable. In the Tanaland province the fertile districts of the Lamu and lower Tana regions are of considerable importance, though here too the fear of Somali raids has to be reckoned with. In the chief coast centres, the commissioner reports a great improvement as having taken place since he first knew them. At Mombasa the streets have been drained, enlarged, and beautified, new roads made, a hotel and bank opened, while a cathedral is in contemplation, and a Hindu temple and Mohammedan temple are nearly completed. Improvements have also been made at Lamu, Malindi, Takaungu, and Kipini, and a pier has been built at Mtanganyiko, a grain-exporting centre at the head of the beautiful Kilifi creek. In the interior a great advance has been made at Nairobi, where excellent roads have been made in all directions, and a fair number of shops opened, while there is a decent hotel and one cab. The flatness of the site (chosen originally merely as a railway centre) is a disadvantage from a sanitary point of view, but the adjoining swamp has been drained and turned into market gardens, while it is intended in future to build principally on the healthy surrounding hills. Sir Charles Eliot fully supports Sir H. Johnston's views as to the suitability of a large part of the interior plateaus for European settlement, which gives to the East Africa Protectorate (now embracing the whole country up to the Victoria lake) its special importance among recent additions to the British Empire. As a field for colonization it is compared with Australia and New Zealand, while it is said to be superior to South Africa, though similar in many ways. Ten years' experience has now shown that European children born in the country can live and thrive there. Among the more favoured districts, in addition to Kikuyu, Kenya, Nandi, Guas Ngishu, etc., the commissioner refers specially to Njoro, occupying the first low slopes of the Mau escarpment, and to the country lying behind Naivasha and east of the rift-valley, which has hitherto been little known, but which a recent visit enables him to pronounce one of the finest districts in the Protectorate. The railway, though not passing through the richest districts, affords a series of points from which they are easily accessible. Wherever Government stations have been established, the natives in the neighbourhood have become peaceable and friendly, the chief difficulties arising from the actions of unscrupulous traders in outlying districts, and from the propensity of the natives to attack caravans of Swahilis and Indians. In spite of rumours regarding the existence of gold-bearing reefs, the future of the country lies in its great agricultural resources, derived both from its indigenous products and its striking capacity for growing those of other countries. It is satisfactory to know that the protection of the valuable forests has been secured by the appointment of a Conservator of Forests. In conclusion, after pointing out that East Africa is the greatest philanthropic achievement of the later nineteenth century, Sir Charles Eliot expresses the opinion that, with proper measures, the country is certain to pay its way in ten years, probably in a much shorter period.

Dr. Hartmann's Explorations in South-West Africa.—Dr. George Hartmann, who last year gave an account of his explorations in the region of the lower Kunene and Ovampo-land, before the Berlin Geographical Society (see the *Zeit-*

schrift of that body, No. 3, 1902) has since given a somewhat fuller narrative in the *Beiträge zur Kolonialpolitik*, published by the German Colonial Society (1902-3, part 13). The journeys were made in 1900 and 1901, one of the main objects being to study the question of a possible railway route from the Otavi copper-mines to the coast. But apart from their results in this direction, they have thrown much new light on the physical features of the country, which, especially in the so-called "Kaoko-Feld" to the south of the Kunene, has hitherto been very imperfectly known. This region was explored in 1900, great difficulties being experienced from the nature of the country. The chief characteristic is the terrace-formation, which is prolonged beyond the Kunene into Portuguese territory. The coast-plain, or first terrace, is bounded to the east by a line of hills and sand-dunes, beyond which lies the higher "Namib" plain, while this again leads to an exceedingly broken mountainous zone, consisting in great part of table mountains, which are the outliers of the great interior plateau which lies still further east. A vast number of watercourses run down between these mountains, and though dry for a great part of the year, the underground water is sufficient to support a considerable vegetation; and as in the south their beds can be traced to the sea, they there form bridges, as it were, by which the otherwise waterless plain can be crossed with ease. In the north they all disappear in the line of sand-dunes, and the coast region is here particularly inhospitable and difficult to travel through. It was found that the various watercourses (one of which was discovered for the first time) had been placed too far north on the existing maps, and that their direction had also been shown inaccurately. In the mountain valleys the vegetation is luxuriant, becoming more and more tropical towards the north. Palms reach far to the south of the Kunene, and in the northern section vegetation extends westward to the line of dunes, among which grass is often found. The dunes vary greatly in extent, reaching their maximum in the neighbourhood of the Kunene and Hoanib. Although quite possible routes for a railway were found, the conditions on the coast proved very unfavourable for a landing-place, and it was therefore proposed to carry the line in a north-west direction across the Kunene to a port in Portuguese territory, which would have the advantage of being nearer Europe, while the line would in this case be of greater value as part of a transverse system of communication across South Africa. To study the possibilities of such a line was the object of Dr. Hartmann's journey through Ovampo or Ambo-land in 1901. The passage through this rich park-like country was effected without difficulties with the natives, and the Kunene reached at Otjipempadiva. Dr. Hartmann then explored the region below the first cataract of the Kunene, and found it to be an excessively wild mountainous tract abounding in big game, and covered with an almost impenetrable thorny scrub. He, however, discovered a good crossing-place for a railway below the second cataract, and an easy route thence to Port Alexander, while he also visited the third cataract, an imposing fall of over 300 feet, hitherto undescribed. He thinks that in time of flood it can hardly be inferior in grandeur to Niagara or the Victoria falls. Dr. Hartmann, who is sanguine as to general possibilities of the German territory, considers that the "Kaoko-Feld" possesses many advantages for a European settlement, one being the present scarcity of population. The thickly peopled Amboland, split up between a number of independent tribes, will present more difficulties to the extension of German control, but a judicious policy will, Dr. Hartmann thinks, lead to the desired result without the employment of force.

Captain Lenfant's New Expedition.—With the joint support of the Paris Geographical Society, the French Colonial Office, the Comité de l'Afrique Française, and the Académie des Inscriptions et Belles Lettres, Captain Lenfant has

started on a new and important expedition to the Niger basin. Entering by the Forcados mouth, on which one of the French *enclaves* is situated, he proposes to ascend the Niger and Benue and make his way to Lake Chad by the Tuburi marsh and the Logone, studying the hydrographical connection between the basins of the Benue and Shari, and its possible utilization as a navigable waterway from the Atlantic to the Central Sudan. Captain Lenfant, who has secured the co-operation of MM. Delevoye and Lahure, will execute a careful survey, and may possibly make his way home by way of the Nile.

AMERICA.

History and Influence of the Wabash Trade Route.—An instructive study, which brings out clearly the influence exerted by a natural line of communication on the economic development of a region, has been undertaken by Mr. E. J. Benton, of the Johns Hopkins University, and published as one of the "Studies" issued by that body (Series xxi. Nos. 1 and 2). The importance of the Wabash route as a means of communication dates back to the days of the early French adventurers, who pushed towards the Mississippi from the great Canadian lakes for the purposes of the fur trade, although other more westerly routes, notably that from Lake Michigan to the Illinois, had come earlier into use, only to yield in time before the natural advantages possessed by the more direct route from Lake Erie to the Wabash and Ohio. The first use of the latter seems certainly due to La Salle, though it was only after the founding of Fort Pontchartrain by Cadillac, on the site of the modern Detroit (1701), and the gradual extension of the French posts towards the lower Wabash (1719–1727), that its pre-eminence was fully established. For many years after this the French and English struggled for the strategic points along the Wabash line, but under the eventual English occupation, and still more after the severance of political connection with the St. Lawrence valley, its significance as a highway declined, to be revived, however, in the nineteenth century, when the increasing tide of westward emigration rendered the improvement of communications between the east and west of the United States an imperative necessity. In the second section of his work Mr. Benton traces the progress of the agitation, which, after many delays, led to the construction of the Wabash and Erie canal by the States of Indiana and Ohio; while in the third, which is of special interest to geographers, he considers the influence which this route has had on the development of the "Old North-West," as the region first touched by the westward movement from the Atlantic States is sometimes called. He points out that it does not suffice, for an understanding of the history of this region, to trace the inflow of the immigrants through the great Appalachian gateways, but the further distributing forces must also be taken into account. The Wabash route formed one of the natural highways which invited the settler to push onward, and was of especial influence before the construction of railroads had lessened the influence of physical barriers. By reference to statistics and other records, Mr. Benton shows forcibly the effect which the opening of the canal had in enhancing the value of real estate, rapidly increasing the population, and promoting agriculture and commerce in the region which it served; not only making possible the increase in population by giving access to markets for the disposal of produce, but actually supplying that increase by the immigration that passed along it. Its influence is to be traced in the fortunes of many still flourishing towns, which owed their first impetus to it, as well as of others which with it have now lost their importance. Mr. Benton concludes by pointing out that the influence of the Wabash route does not end with the fall of the canal, but is continued by the Wabash railroad, its economic successor.

Meteorology of Jamaica.—In the recently published Colonial Office report on Jamaica, some space is devoted to the meteorology of the island. With regard to the rainfall, the May and October rains are strongly marked throughout the island, but in the north-eastern and northern divisions, which roughly embrace the whole of the north of the island, there are in addition winter rains in December, January, and February, while elsewhere there are, as a rule, summer rains in July and August. In the majority of places there is never a month without some rain, but at times in the drier months there are isolated localities where none falls. Kingston, the capital, is one of the driest places, and Port Antonio, on the other side of the Blue mountains, though only 30 miles distant, is one of the wettest. In the north-eastern division the effect of the vapour-laden trade winds impinging upon high mountain ranges is well shown, and here the total fall in some part exceeds 200 inches. The west central region comes next in elevation, coolness, and rainfall. The northern is largely an elevated and undulating table-land of limestone ridges and valleys; the southern contains the chief plains in the island. These two last-named divisions are comparatively dry. The average rainfall for the last three decades, 1870–79, 1880–89, 1890–99, is given as 67·4, 66·5, and 76·1 respectively, but last year's record (1901–2) exceeded this considerably, averaging 80·9 inches. The mean temperature is shown to be 78·8 Fahr., varying from 75·7 in February to 81·6 in July. The report announces the severance of the connection of Mr. Maxwell Hall, the Government Meteorologist, with what remains of the Weather Service Department, which he established in 1880. For some three years past economy has necessitated retrenchments, and it is now decided that the compilation of the weather report shall in future be undertaken by the Chemist's Department.

The Furos de Breves, Amazon River.—In 1900 Dr. J. Huber explored the network of *furos*, or channels, which connect the Amazons and the Pará estuary, extending from the F. Tajapurú eastwards to the Rio Amará. The islands which so thickly stud the Pará estuary are either of old formation, and consist of sandy and clayey deposits with beds of the characteristic sandstone of Pará, or are of recent alluvial formation. To the second class belong all the islands enclosed by the Furos de Breves, and they occupy, in Dr. Huber's opinion, an area which was formerly a broad channel connecting the Amazons with the Pará. There is no foundation for the view that the furos have been cut through continuous land. The tide ascending the Pará meets the descending water of the Amazons in the furos at points known to the local inhabitants as *encontros d'aguas* (meetings of waters). The silt-laden water of the Amazons, which still finds its way out through the Pará in considerable quantity during the ebb, is thus dammed up at high tide, and the stagnation allows the silt to settle down. The process of island formation may be still witnessed. A bank is formed, which at length rises above the water, and is gradually covered with vegetation, the first forms to appear being *Montrichardia arborescens* and *Drepanocarpus lamatus*, the seeds of which can swim for some time on water, and these are soon joined by mangroves. As the islands increase in size the channels between them become more restricted, and the land at length assumes the appearance of having been intersected by furos. These have a breadth varying from 50 to 500 yards, and a depth of 30 to 180 feet. Their affluents are the *igarapés*, which originate in marshy tracts of forest called *igapós*. Most of the land is inundated in the rainy season, and a fresh deposit of silt is laid down on it. A similar region of furos occurs in the north-west of the island Marajo. The channels there are also subject to fluctuations caused by the tide, but they belong entirely to the hydrography of the Amazons, and have now no connection with the Pará. The streams coming from the centre of the island

were no doubt formerly branches of the Amazon delta, for the *igapós* and lakes in which they rise communicate with rivers flowing in the opposite direction. West of the Tajapurú the contrary movement has taken place, and the furos are cut off from the Amazons and communicate only with the Pará. Dr. Huber describes fully the vegetation of the furo region.—*Boletim do Museu Paraense*, vol. iii. Nos. 3 and 4.

The Lower Orinoco.—Observations made during a voyage on the lower Orinoco in October last by the German warship *Panther*, and summarized in the *Annalen der Hydrographie* (1903, part 4), supplement and correct in many ways the information given on existing charts. On entering by the Boca Grande, the bar, the position of which is shown by no mark on the coast, could not at first be found, and the smallest depth revealed by sounding was 5·6 metres (18 feet). The Indian pilot, who had been taken on board at Port of Spain, followed in the main the course laid down on the American chart; but as the course adopted varies at different times of year and according to the direction of the voyage, no definite line can be laid down. The *Panther* anchored each night, and soundings and observations of the rate of current were then taken; but as the anchorages were often sheltered by projecting points, the latter do not represent the rate of current in mid-stream. Thus the observed rate off Ciudad Bolivar was only 2 nautical miles, while in the centre it is placed at 4 miles and over. The depths at the anchorages varied from 13·5 to 27 metres (45 to 90 feet). Although the state of the river has little influence on the depth on the bar, the difference between high and low water amounted to 7 metres (23 feet) and more at Cuidad Bolivar. From January to March no depths greater than 10 feet can be depended on, and ships drawing as much water as the *Panther* cannot navigate the river after December. The primæval forests which clothe the banks of the Boca Grande and extend with little intermission to Barrancas, give place higher up to tall bush with many clearings. Above Barrancas the principal places are Guiana Vieja (with two forts placed on a spur of the southern mountain chain), and Las Tablas, the latter being of some importance as the starting-point of a road to the mining region in the south. A number of points are enumerated in which the existing charts of the river are inaccurate.

Vegetation of the Galapagos Islands.—The Galapagos islands have, since Darwin's visit on the *Beagle*, been explored by numerous travellers. The botanical results obtained by the latter have been compiled and published in a condensed form by Mr. B. L. Robinson in the *Proceedings of the American Academy of Arts and Science* (vol. 38, No. 4, Oct. 1902, pp. 77–270, 3 plates). A list of the species so far observed on the islands is given, and their geographical distribution on the separate islands, as far as they have been explored. This is followed by an account of the general features of the flora. Generally speaking, the vegetation of the islands up to 300 metres is extremely xerophil; beyond that the climate is moister, the plants being consequently more hygrophil, and it is here that a few trees, never very high, are found. Of the 590 vascular plants found on the islands 40·5 per cent. are endemic. The affinities of the flora are discussed at some length, as evidence regarding the origin of the whole group of islands. The islands are generally held to be of independent volcanic origin, and to have emerged from the ocean without ever having been in connection with the American continent; the species met with owing their origin to seeds which chance has brought on to the islands. Another theory, elaborately worked out by Dr. Baur, supposes the Galapagos islands to have been separated from the American continent by an extensive subsidence. The botanical evidence, according to the author, "is opposed rather than favourable to the subsidence theory." The remarkable difference

between the florulæ of the various islands themselves and the American continent is adduced as an argument against such a theory. At the same time, Baur has advanced biological arguments in favour of his hypothesis, which still remain unanswered. The whole paper is a very valuable contribution to geobotany in general, and our knowledge of the Galapagos islands in particular.

POLAR REGIONS.

Antarctic Relief Expedition.—The urgent need of sending once more a relief expedition in support of the *Discovery* having been recognized by the British Government, it has been decided to despatch such an expedition this year under the orders of the Admiralty. The *Morning*, which since her return from her first voyage has been lying at Lyttelton, New Zealand, in readiness for a second advance south at the end of the present year, has therefore been made over to the Admiralty authorities, while a second ship, the *Terra Nova*, has been acquired in Newfoundland, and will accompany the *Morning* as an additional precaution against possible mishap. She has been brought to Dundee, where the work of refitting and taking on board the necessary stores has been proceeded with energetically, with a view to the ship starting for New Zealand about the end of August. In this work the authorities have had the assistance of Captain Colbeck, who arrived in England towards the end of July, and who will again have the command of the expedition, the captain of the *Terra Nova* being Captain Harry Mackay, whaling master, who has had considerable experience of Arctic navigation, both as master of the *Terra Nova* when the vessel belonged to the Dundee whaling fleet, and when in command of the yachts *Eskimo* and *Blencathra* (owned by Mr. Barclay Walker and Mr. Coates respectively) during their cruises in the Arctic seas. Her crew will be entirely a mercantile one, composed chiefly of whalers of experience. In order to save time, as the season is somewhat far advanced, the *Terra Nova* will proceed to New Zealand *viâ* the Suez canal, being escorted through the Mediterranean by the cruiser *Minerva*. In case it should be found impossible to extricate the *Discovery* in time to return early next year, the officers, scientific staff, and crew of the latter vessel will be taken on board one or other of the relief ships. It is to be confidently expected, however, that the measures to be taken by Captain Scott during the coming Antarctic summer will result in the setting free of the vessel, as the time available for the operations will be so much greater than was the case last season, when the time taken by the sledge expeditions, and the full expectation that the vessel would be set free by the annual break-up of the ice, naturally delayed the commencement of the work until the summer was already far advanced.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

River Curves and Entrance of Tributaries.—Prof. Davis, in the April number of the *Geological Magazine*, agrees with Dr. Callaway that tributaries enter meandering streams on the convex sides of the curves (cf. *Geographical Journal*, February, 1903, p. 193). He disagrees, however, with Dr. Callaway's explanation, and points out (1) that rivers are not initially quite straight; (2) that the initial bends tend to develop into meanders; (3) that the meander system tends to move down the valley; (4) that this explains the entrance of tributary streams at the convex sides of meanders, any stream which originally did not do so being ultimately captured by the approaching meander; (5) that cut-offs occur here and there; (6) that these cut-offs are not straight, and tend to develop into meanders (cf. edition of preliminary maps of Mississippi River Commission, St. Louis, 1900–1901); (7 and 8) exceptions to (4) are where a tributary

follows the old bed to a cut-off, or enters a river flowing through relatively narrow meandering valley (lower Wye, Seine, Moselle, or north branch of Susquehanna).

The Development of River Terraces.—In an elaborate paper on "River Terraces in New England" (*Bull. Museum Comp. Zoöl.*, Harvard, xxxviii.), Prof. W. M. Davis discusses the evolution of terraces in valleys which have been filled with glacial drift through which the river is still cutting its way. The conclusions to which he comes are—"First, a diminution of stream volume may have taken place during the terracing of our New England valleys, but it has not been essential to the production of the observed terraces. Second, the terracing rivers have slowly degraded their aggraded valleys while actively swinging from side to side; degradation probably being the result of the combined action of a slow northern uplift and a gradual decrease of load, and in spite of a probable decrease of volume. Third, the chance discovery of rock ledges by the swinging river is the chief cause of the systematic diminution of interscarp spaces and of the preservation of terraces, as seen in a typical section of stepping terraces." He then develops a theory of river terraces in which he traces the successive terrace forms shaped by a free-swinging, slowly degrading river, and then the constraints imposed by "the accidental encounter with previously buried ledges at various points in its course and at various stages in its history." This he illustrates by a series of ingeniously devised "solid" diagrams, showing the various patterns of terraces which can be formed by such processes of river-action as are involved in the theory; and finally these are compared with the actual terraces in New England. As in most of Prof. Davis's papers, an attempt is made to employ a systematic terminology. Among the more general expressions used are *meander belt*, for the space enclosed between tangents drawn outside the curves or meanders of a stream; *sweeping*, for the progressive movement of meanders down a valley; *swinging*, for the lateral movement of the meander belt from one side of the valley floor to the other; *wandering*, for the compound movement of sweeping and swinging; and *belt of wandering* for the whole breadth of the valley floor that may be worn down by the stream, which corresponds to the flood plain, which is in New England locally termed an "interval." Cut-offs, ox-bow lakes, and cusps are now well-known terms of American authors. Prof. Davis in this paper uses the term *short-cuts* for channels formed during floods, which straighten the river but are not necessarily cut-offs, and *lobes* for the land bounded on all but one side by a bend of the river on the plain

The Employment of Means in Meteorology.—Those who make use of the results of meteorological research without being themselves experts in that science must frequently have experienced a doubt as to the justification for the general use of mean values of meteorological elements as representing the normal or most probable values for such elements. The same doubt has forced itself upon the mind of the well-known French meteorologist, Prof. Angot, who points out in the *Comptes Rendus* of the Paris Academy of Sciences (May 18, 1903), that such use of means could only be considered legitimate if it were shown that the natural causes which bring about a variation from the mean act in precisely the same way as the purely fortuitous causes which operate generally in cases of variation. In order to test the actual existence of this condition, he has examined the records of temperature for France for the fifty years 1851–1900, obtaining the mean for each month, and the actual deviations from the mean, and thus deducing the probable error in any particular case. He has then found the number of observations (out of the total of 600) in which the actual deviation from the mean has equalled or exceeded various multiples of the calculated probable error, and compared the results with those deduced theoretically in the case of purely fortuitous causes of variation. The agreement is surprisingly complete, and Prof. Angot concludes that

for France, at least, the arithmetical mean of the temperatures observed for any given month for a series of years is at the same time the most probable value of such temperature, and the one which will occur most frequently. The employment of means is therefore justified for France and for the particular meteorological element in question, but Prof. Angot notes that in the case of rainfall the significance of the mean is more than open to doubt. This seems borne out by the recent calculation of the mean rainfall of London for a series of years, given in 'British Rainfall' for 1902, which shows that the results on the basis of 90 years' observations are decidedly different from those on one of 60. Prof. Angot also notes that his period of fifty years is not sufficiently long to give the absolute mean with any great exactness. Would it not, however, be the case that, granted the possibility of long-period variations of climatic elements, the mean obtained from observations within a less number of years would give more nearly the probable value of any element within the same period than one based on a longer series?

GENERAL.

Commercial Geography at Manchester.—Mr. John M°Farlane, M.A. (Edinburgh and Cantab.), has been appointed Lecturer in Political and Commercial Geography in the Owens College, Manchester. Mr. M°Farlane has hitherto devoted his attention to history and economics, but we understand that he will spend a term at the School of Geography at Oxford before entering on his duties at Manchester.

CORRESPONDENCE.

Stone Figures in China.

Northbrook House, Bishops Waltham, Hants, August 11, 1903.

As regards "Stone Figures in China," p. 210 of the August *Geographical Journal*, Mr. Bourne's "Notes of a journey to the Imperial Mausolea East of Pekin" (*Proc. R.G.S.* (1883), vol. v. p. 23) show that stone figures of men and animals in parallel rows line the approaches to some of the tombs of the present Manchu dynasty; the explanation given by a Chinese, and accepted by Mr. Bourne, being "the stone figures are to a dead emperor what the pageantry and display of a court are to the living one." The Manchus may have adopted this custom from the Chinese, and, if so, the explanation given to Dr. Sewell M°Farlane that the stone figures he saw were at the entrance to the tomb of a prime minister is probably correct. Mr. Bourne refers to a paper in the *Journal* of the Shanghai Branch of the Royal Asiatic Society for 1878, by Mr. W. F. Myers, "On the Stone Figures at Chinese Tombs, and Offerings of Living Sacrifice," which may throw more light on the subject.

H. W. Trinder.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. = Memoirs, Mémoires.
Met. = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps. **Baedeker.**
The Eastern Alps, including the Bavarian Highlands, Tyrol, Salzburg, Upper and Lower Austria, Styria, Carinthia, and Carniola. Handbook for Travellers by Karl Baedeker. Tenth Edition, revised and augmented. Leipzic: K. Baedeker, 1903. Size 6½ × 4, pp. xxvi. and 572. *Maps, Plans, and Panoramas. Price* 10 *m. Presented by the Editor.*

Austria—Levelling. *M.K.K. Militär-G.I.* **22** (1902): 110–120. ——
Die Fortsetzung des Präcisions-Nivellements, ausgeführt im Jahre 1902.

Balkan Peninsula. *Sitzb. K.A.W. Wien* **110** (Ab. I.) (1901): 437–478. **Cvijić.**
Die dinarisch-albanesische Scharung. Von Prof. J. Cvijić. *With Map.*

Balkan Peninsula. *Sitzb. K.A.W. Wien* **110** (Ab. I.) (1901): 409–432. **Cvijić.**
Die tektonischen Vorgänge in der Rhodopemasse. Von Prof. J. Cvijić. *With Map and Profiles.*

Balkan Peninsula. **Haardt.**
M.K.K. Militär-G.I. **21** (1901): 136–300; **22** (1902): 155–489.
Die Kartographie der Balkan-Halbinsel im xix. Jahrhunderte. Von V. Haardt von Hartenthurm.

Bulgaria—Census. *Deutsch. Rundschau G.* **25** (1903): 467–469. ——
Zur letzten Volkszählungsstatistik des Fürstentums Bulgariens.

Europe—Ethnology. *Globus* **83** (1903): 333–335. **Wilser.**
Das Verbreitungszentrum der nord-europäischen Rasse. Von Dr. L. Wilser.

Europe—Political. *Deutsch. Rundschau G.* **25** (1903): 396–403. **Mucha.**
Geographische Sonderbarkeiten. Von J. Mucha.
On small, more or less independent sovereignties and communities in Europe.

Faroe Islands. **Villiers.**
Trade and Laws of the Faroe Islands, Foreign Office, Annual No. 2984. Size 10 × 6, pp. 48. *Price* 2½*d.*

France—Calvados. *C. Rd.* **136** (1903): 1345–1347. **Bigot.**
Sur la géologie du pays de Cinglais (Calvados). Note de A. Bigot.

France—Coasts. *B.G. Hist. et Descriptive* (1902): 349–402. **Pawlowski.**
Les transformations du littoral français. Les pays d'Arvert et de Vaux d'après la géologie, la cartographie et l'histoire. Par A. Pawlowski. *With Maps.*

France—Corsica. *C. Rd.* **136** (1903): 1705–1707. **Castelnau.**
Observations sur des phénomènes de glaciation en Corse. Note de P. Castelnau.

France—Geology. **Barré.**
Commt. O. Barré. L'Architecture du Sol de la France. Essai de Géographie Tectonique. Paris: A. Colin, 1903. Size 10 × 6½, pp. iii. and 394. *Diagrams. Price* 12 *fr. Presented by the Publishers.* [To be reviewed.]

France—Navigation. *Contemporary Rev.* **83** (1903): 797–819. **Baudin.**
The Internal Navigation of France. By Pierre Baudin. *With Map.*

France—Nord. *B. Union G. Nord de la France* **24** (1902): 193–233. ——
Industrie Lainière de la Région de Fourmies.

France—Picardy. *Ann. G.* **12** (1903): 109–119. **Hitier.**
Le village picard. Par H. Hitier. *With Plates.*

France—Pyrenees. *Ann. Club Alpin Français* **28** (1901): 213–241. **Saint-Saud.**
Étude Orographique sur le Bassin Lacustre Occidental du Néouvielle (Hautes-Pyrénées). Par M. de Saint-Saud. *With Map and Illustrations.*

France—Vosges. **Delebecque.**
Contribution a l'étude du système glaciaire des Vosges Françaises. Par A. Delebecque. Paris: C. Béranger, 1901. Size 10 × 6½, pp. 16. *Map. Presented by the Author.*

Germany—Berlin. **Baedeker.**
Berlin and its Environs. Handbook for Travellers. By Karl Baedeker. Leipsic: Karl Baedeker; London: Dulau & Co. 1903. Size 6½ × 4, pp. x. and 238. *Maps and Plans. Price* 3*m. Two copies. Presented by the Editor and Messrs. Dulau & Co.*

Germany—Frankfurt on Main. ——
Beiträge zur Statistik der Stadt Frankfurt am Main. Neue Folge. Fünftes Heft: Die Schülerzählung vom 30. November, 1900. Franfurt-a.-M., 1903. Size 11 × 7½, pp. 38 and cxii. *Diagram.*

Germany—Lakes. *Globus* **83** (1903): 286–287. **Halbfass.**
Zwei Seen in der Moränenlandschaft des Bodensees. (Schleinsee und Degersee.) Von W. Halbfass. *With Map.*

Germany—Saxony. **Ruge.**
Dresden und die Sachsische Schweiz. Von Prof. Dr. Sophus Ruge. (Lande und Leute. Monographien zur Erdkunde . . . herausgegeben von A. Scobel, xvi.) Bielefeld und Leipzig: Velhagen and Klasing, 1903. Size 10½ × 7, pp. 176. *Illustrations. Price* 4*s.*

Iceland. *G. Tidskrift* **17** (1903–1904): 26–41. **Thoroddsen.**
Geografiske og geologiske Undersøgelser ved den sydlige Del af Faxaflói paa Island. Af Prof. Dr. T. Thoroddsen.

Iceland—Archæology. *G. Tidskrift* **17** (1903–1094): 13–25. **Bruun.**
Udgravninger paa Island. Af Kaptajn Daniel Bruun. *With Illustrations.*

Iceland—Surveys. *G. Tidskrift* **17** (1903–1904): 1–12. **Lund-Larssen.**
Meddelelser om Generalstabens Triangulation paa Island i Sommeren 1902. Ved Kaptain Lund-Larssen. *With Map.*

Italy—Historical. **Detlefsen.**
Die Beschreibung Italiens in der Naturalis Historia des Plinius und ihre Quellen. Von Prof. Dr. D. Detlefsen. (Quellen und Forschungen zur alten Geschichte und Geographie, herausgegeben von W. Sieglin. Heft 1.) Leipzig: E. Avenarius, 1901. Size 10 × 6½, pp. 62.

Mediterranean—Cyprus. *P.I. Civil Engineers* **151** (1903): 334–340. **Bellamy.**
The Economic Construction and Maintenance of Roads in the Island of Cyprus. By Charles Vincent Bellamy.

Norway. *Alpine J.* **21** (1903): 396–408. **Ouston.**
In Lofoten and Vesteraalen. By T. G. Ouston. *With Map and Illustrations.*

Norway. **Wood.**
Norwegian By-ways. By Charles W. Wood. London: Macmillan & Co., 1903. Size 8 × 5½, pp. 384. *Illustrations. Price* 6*s. Presented by the Publishers.*

Portugal—Agriculture. *La G., B.S.G. Paris* **7** (1903): 245–277. **Flahault.**
L'économie agricole en Portugal. Par C. Flahault. *With Illustrations.*

Pyrenees. *Ann. Club Alpin Français* **28** (1901): 436–440. **Schrader.**
Note sur la Feuille 4 (et dernière) de la Carte des Pyrénées Centrales au 100,000e. Par M. F. Schrader.

Rhine. **Baedeker.**

The Rhine from Rotterdam to Constance. Handbook for Travellers by Karl Baedeker. Fifteenth Revised Edition. Leipsic: Karl Baedeker; London: Dulau & Co. 1903. Size 6½ × 4, pp. xxxiv. and 456. *Maps and Plans. Price* 7 *m. Two copies, one presented by the Editor, and the other by Messrs. Dulau & Co.*

Russia—Black Sea Coasts. **Sokolow.**

Verh. Russ.-K. Mineralog. Ges. St. Petersburg **40** (1902): 35-112.

Der Mius-Liman und die Entstehungszeit der Limane Süd-Russlands. Von Dr. N. Sokolow. *With Maps.*

Russia—Towns. *B.S.G. Lille* **39** (1903): 309-386. **Moriamé.**

En Russie. Les grandes villes de la Russie d'Europe. Par E. J. Soil de Moriamé. *With Illustrations.*

Sweden.

Svenska Turistföreningens Årsskrift för År 1903. Stockholm: Wahlström & Widstrand, 1903. Size 8½ × 5½, pp. viii. and 448. *Illustrations. Price* 4 *kr. Presented by the Publishers.*

Switzerland—Grisons. *M. Antiquar. Ges. Zürich* **26** (1903): 1-80. **Heierli and Oechsli.**

Urgeschichte Graubündens mit Einschluss der Römerzeit. Von J. Heierli und W. Oechsli. *With Map and Illustrations.*

Switzerland—Simplon. *B.S.G. l'Est* **24** (1903): 23-29. **Papelier.**

Les voies d'accès au Simplon. Par A. Papelier.

Switzerland—Zermatt. **Whymper.**

The Valley of Zermatt and the Matterhorn. A Guide by Edward Whymper. Seventh Edition. London: John Murray, 1903. Size 7½ × 5, pp. xiv. and 224. *Maps and Illustrations. Price* 3*s. net. Two copies, presented by the Author and Publishers.*

Turkey—Albania and Macedonia. **Šoštarić.**

Deutsch. Rundschau G. **25** (1903): 337-347.

Durch Albanien und Makedonien. Von Dr. M. Šoštarić. *With Illustration.*

Turkey—Gulf of Salonica. *Petermanns M.* **49** (1903): 91-93. **Philippson.**

Eisbildung auf der Bucht von Saloník im letzten Winter. Von A. Philippson. *With Map.*

United Kingdom—Ireland. *Nineteenth Century* **53** (1903): 876-882. **Sankey.**

A Future for Irish Bogs. By Sir R. H. Sankey, K.C.B.

United Kingdom—Ireland. **McCarthy.**

Ireland and Her Story. By Justin McCarthy. London: Horace Marshall & Son, 1903. Size 7 × 4, pp. 190. *Map. Price* 1*s.* 6*d. Presented by the Publishers.*

United Kingdom—Quarries.

Quarry **7** (1902): 749-752; **8** (1903): 77-83, 141-145.

The Whinstone and other Road Metal Quarries of the North of England. *With Maps and Illustrations.*

United Kingdom—Reading. **Blake.**

Memoirs of the Geological Survey. England and Wales. The Geology of the country around Reading. (Explanation of Sheet 268.) By the late J. H. Blake. With contributions by W. Whitaker. Edited by H. W. Monckton. London: E. Stanford, 1903. Size 10 × 6, pp. 92. *Illustrations. Presented by the Geological Survey.*

United Kingdom—Scotland. **Baddeley.**

Thorough Guide Series. Scotland (Part i.), Edinburgh, Glasgow, and the Highlands, as far north as Aberdeen, Inverness, Gairloch, and Stornoway, with a description of the various approaches by Land and Sea from the South. By M. J. B. Baddeley. Tenth Edition. London: Dulau & Co., 1903. Size 6½ × 4½, pp. 20, xxxii., and 348. *Maps and Plans. Price* 6*s.* 6*d. Presented by the Publishers.*

United Kingdom—Scotland. **Baddeley.**

Thorough Guide Series. Scotland (Part iii.), The "Lowlands," including Edinburgh and Glasgow, and all Scotland south of those places. By M. J. B. Baddeley. Fourth Edition. London: Dulau & Co., 1903. Size 6½ × 4½, pp. xii. and 186. *Maps and Plans. Price* 4*s. Presented by the Publishers.*

All the sectional maps are coloured in this edition, and a new plan of Ayr is given.

The two large-scale section maps of the Ayr district are, however, omitted, though reference is still made to them in the appendix on coach tours, where some confusion seems also to have been introduced in the course of condensation.

United Kingdom—Scotland. **Various Authors.**

Memoirs of the Geological Survey. Scotland. The Geology of North Arran, South Bute, and the Cumbraes, with parts of Ayrshire and Kintyre. (Sheet 21, Scotland.) Glasgow; London: E. Stanford, 1903. Size 10 × 6, pp. viii. and 200. *Illustrations. Price* 4*s. Presented by the Geological Survey.*

ASIA.

Asia. *Deutsch. Rundschau G.* **25** (1903): 439–454. **Jüttner.**

Fortschritte der geographischen Forschungen und Reisen im Jahre 1902. I. Asien. Von Dr. J. M. Jüttner.

Central Asia. **Hedin and Dove.**

Meine letzte Reise durch Inner-Asien. Von Prof. Dr. Sven von Hedin. Mit einer Einleitung von Prof. Dr. Dove. Halle-a-S.: Gebauer-Schwetschke Druckerei und Verlag, 1903. Size 9½ × 6½, pp. xiv. and 50. *Map and Portrait. Presented by the Publisher.*

Ceylon—Veddas. *Globus* **83** (1903): 201–207, 220–223, 261–267. **Rütimeyer.**

Die Nilgalaweddas in Ceylon. Von. Dr. L. Rütimeyer. *With Illustrations.*

China—Terrestrial Magnetism. *B.S.G. Italiana* **4** (1903): 178–185. **Bertelli.**

Se da alcuni documenti si possa dedurre l'antica conoscenza della "Declinazione magnetica" presso i Cinesi. Nota del P. T. Bertelli.

China—Wei-Hai-Wei. *G. Teacher* **2** (1903): 66–70. **Bruce-Mitford.**

Wei-Hai-Wei. Some Physical Characteristics of our New Dependency in the Far East. By C. E. Bruce-Mitford. *With Map and Illustration.*

Chinese Empire—Tibet. *Z. Ges. Erdk. Berlin.* (1903): 344–358. **Hedin.**

Seen in Tibet. Von Dr. Sven v. Hedin. *With Illustrations.*

Chinese Turkestan. **Stein.**

Sand-Buried Ruins of Khotan. Personal Narrative of a Journey of Archæological and Geographical Exploration in Chinese Turkestan. By M. Aurel Stein. London: T. Fisher Unwin, 1903. Size 9 × 5½, pp. xliv. and 524. *Map and Illustrations. Price* 21*s. net. Presented by the Publishers.* [To be reviewed.]

French Indo-China. *Rev. G.* **52** (1903): 503–515. **De la Peyre.**

Les communications en Indo-Chine, voies fluviales et voies ferrées. Par Jean de la Peyre. *With Map.*

India. *Records Botan. Surv. India* **2** (1903): 231–370. **Prain.**

Flora of the Sundribuns. By D. Prain. *With Map.*

India—Bombay. ——

Magnetical, Meteorological, and Seismological Observations made at the Government Observatory, Bombay, in the Years 1900 and 1901, under the direction of N. A. F. Moos. With an Appendix. Bombay, 1903. Size 13½ × 10, pp. xxii., 40, 26, and 8. *Price* 7*s. Diagrams. Presented by the Indian Government.*

India—Sind. *J.S. Arts* **51** (1903): 593–610. **Birdwood.**

The Province of Sind. By H. M. Birdwood, C.S.I. *With Map.*

India—Surveys. ——

General Report on the Operations of the Survey of India administered under the Government of India during 1901–1902. Prepared under the direction of Colonel St. G. C. Gore. Calcutta, 1903. Size 13½ × 8½, pp. iv. and 62, and x. *Maps and Portrait. Price* 3*s. Presented by the Survey of India Department.*

India—Western Frontiers. *Imp. and Asiatic Quarterly Rev.* **15** (1903): 225–252. **Rees.**

The Western Frontiers of India. By J. D. Rees.

Indian Ocean. *Monthly Weather Rev.* **31** (1903): 127–133. **Harris.**

The semi-diurnal tides in the northern part of the Indian Ocean. By R. A. Harris. *With Diagrams.*

Japan. *J.G., Tōkyō G.S.* **14** (1902): 620–629. **Ogawa.**

Influences of Geographical Features on the Civilization of Japan. By Takudyi Ogawa. [In Japanese.]

Japan. *Deutsch. Rundschau G.* **25** (1903): 349–351. **Nishimura.**

Der Ausbruch des Torishima in Japan. Von M. Nishimura. *With Map and Illustrations.*

See account of the eruption in the *Journal* for May last.

Japan—Formosa. **Davidson.**

The Island of Formosa, Past and Present. History, People, Resources, and Commercial Prospects. Tea, Camphor, Sugar, Gold, Coal, Sulphur, Economical Plants, and other productions. By James W. Davidson. London, etc.: Macmillan & Co., 1903. Size 11 × 8, pp. iii., 5, 646, xxviii., and 46. *Maps, Plates, and Illustrations. Price 25s. net. Presented by the Publishers.* [To be reviewed.]

Korea—Place-names. **Kotô and Kanazawa.**

A Catalogue of the Romanized Geographical Names of Korea. By B. Kotô and S. Kanazawa. Published by the University of Tôkyô, [1903]. Size 8 × 4½, pp. vi., 90, and 88. *Presented by the Authors.*

Malay Archipelago—Celebes. *Globus* **83** (1903): 277–281. **Sarasin.**

Ueber die Toála von Süd-Celebes. Von P. und F. Sarasin. *With Illustrations.*

Pamirs. *Izvestiya Imp. Russ. G.S.* **38** (1902): 273–305. **Fedchenko.**

Pamir and Shugnan. By B. A. Fedchenko. [In Russian.]

Philippine Islands. **Blair, Robertson, and Bourne.**

The Philippine Islands, 1493–1803. Explorations by Early Navigators, Descriptions of the Islands and their Peoples, their History, and Records of the Catholic Missions, as related in contemporaneous Books and Manuscripts, showing the Political, Economic, Commercial, and Religious Conditions of those Islands from their earliest relations with European Nations to the beginning of the Nineteenth Century. Translated from the Originals. Edited and Annotated by Emma Helen Blair and James Alexander Robertson, with historical introduction and additional notes by Edward Gaylord Bourne. Vol. i. 1493–1529 (pp. 358); vol. ii. 1521–1569 (pp. 336); vol. iii. 1569–1576 (pp. 318); vol. iv. 1576–1582 (pp. 320). Cleveland, Ohio: The A. H. Clark Co., 1903. Size 9½ × 6. *Maps, Portraits, and Illustrations. Price* $4 *net per volume.*

This important series will extend to 55 volumes, one to be issued each month.

Russia—Caucasia. *Ann. Club Alpin. Française* **28** (1901): 319–335. **Leprince-Ringuet.**

Souvenirs de Russie. Ascension du Grand-Ararat. Par M. F. Leprince-Ringuet. *With Illustrations.*

Russia—Caucasus. *Materials Topog., etc., Caucasus* **31** (1902): 49–96. **Han.**

Journey in Kakhetia and Daghestan in 1898. By K. F. Han. [In Russian.]

Russian Central Asia. *Zemlevyedenie* **9** (1902): 71–75. **Anuchin.**

A former mouth of the Amu-Daria in the Caspian Sea. By D. Anuchin. [In Russian.]

Russia—Sakhalin. **Labbé.**

Paul Labbé. Un Bagne Russe. L'île de Sakhaline. Paris: Hachette et Cie, 1903. Size 7½ × 4½, pp. 276. *Maps and Illustrations. Price 4fr. Presented by the Publishers.* [See review, *ante*, p. 318.]

Russia—Siberia—Amur. **Khlaponin and others.**

Explorations Géologiques dans les Régions aurifères de la Sibérie. Région aurifère de l'Amour. Livr. iii. St. Petersburg, 1902. Size 10 × 6½, pp. 171. *Maps.*

Russia—Siberia—Baikal. *Zemlevyedenie* **9** (1902): 33–40. **Anuchin.**

Baikal (short sketch). By D. Anuchin. [In Russian.]

Russia—Siberia—Baikal. *Zemlevyedenie* **9** (1902): 41–65. **Korotneff.**

Zoogeographical researches on Baikal. By A. Korotneff. [In Russian.] *With Map and Illustrations.*

Siam—Railways. *B. Comité l'Asie Française* **3** (1903): 142–145. ——

Les Chemins de fer au Siam et les rivalités anglo-allémandes. *With Map.*

Turkey—Baghdad Railway. *Missions Belges* **5** (1903): 117–131, 153–169. **Lammens.**

La future route des Indes. Par Père H. Lammens. *With Map and Illustrations.*

Turkey—Palestine. **Sanday and Waterhouse.**

Sacred Sites of the Gospels. By W. Sanday, with the assistance of Paul Waterhouse. Oxford: Clarendon Press, 1903. Size 9 × 5½, pp. xii. and 126. *Maps,*

Plans, and Illustrations. Price 13*s.* 6*d. net. Presented by the Delegates of the Clarendon Press.*

Turkey—Syria. *Asien* **2** (1903): 107–109, 125–128. **Schlagintweit.**

Die Häfen der syrischen Küste und die Deutsche Levante-Linie. Von Major Max Schlagintweit. *With Map.*

AFRICA.

British Central Africa. *Scottish G. Mag.* **19** (1903): 311–315. **Henderson.**

The Nyasa Coal Bed. By Rev. James Henderson. *With Illustrations.*

British East Africa. [Eliot.]

Africa No. 6 (1903). Report by His Majesty's Commissioner on the East Africa Protectorate. London: Eyre & Spottiswoode, 1903. Size 13½ × 8½, pp. 48. *Price* 5*d.*

See note in the Monthly Record (*ante*, p. 330).

Canary Islands. **Taquin.**

B.S.R. Belge G. **26** (1902): 28, 131, 266, 315, 405, 502; **27** (1903): 37.

Les Iles Canaries et les Parages de Pêche Canariens. Par Dr. A. Taquin. *With Maps and Illustrations.*

Central Africa. **Moore.**

The Tanganyika Problem. An Account of the Researches undertaken concerning the existence of Marine Animals in Central Africa. By J. E. S. Moore. London: Hurst & Blackett, Ltd., 1903. Size 9½ × 6½, pp. xxiv. and 372. *Maps and Illustrations. Presented by the Publishers.*

Reviewed in vol. xxi. (p. 288).

Central Africa—Tanganyika. **Dupont.**

Miss. Catholiques **35** (1903): 56–59, 65–69, 76–80.

Souvenirs du Tanganika. Par Mgr. Dupont. *With Illustrations.*

Central Africa—Zoology. *P. Zoolog. S.* (1902, II.): 339–350. **Major.**

On a Specimen of the Okapi lately received at Brussels. By C. I. Forsyth Major. *With Illustrations.*

Congo State. *Mouvement G.* **20** (1903): 103–106. **Du Bourg.**

L'expédition du Bourg de Bozas dans le bassin de l'Uele. *With Map.*

Egypt. **Abbate.**

Dr. Abbate Pacha. Le Reservoir D'Assouan et le projet du Canal Abbas au point de vue sanitaire. Le Caire, 1903. Size 9½ × 6½, pp. 16.

The author considers that risk to health will arise from the stagnant water held up by the reservoir.

Egypt. **Beadnell.**

Neolithic Flint Implements from the Northern Desert of the Fayûm, Egypt. By Hugh J. L. Beadnell. (Extracted from the *Geological Magazine*, N.S., Decade iv. vol. x. pp. 53–59, February, 1903.) London: Dulau & Co. Size 8½ × 5½. *Plates. Presented by the Author.*

Egypt. *Tour du Monde* **9** (1903): 301–312. **Beaumont.**

L'Irrigation de l'Égypte et les nouveaux Barrages d'Assouan et d'Assiout. Par Gaston du Boscq de Beaumont. *With Illustrations.*

Egyptian Sudan. *Monthly Rev.* **11** (1903): 89–99. **Ward.**

The Wonders of the Sudan. By J. Ward. *With Illustrations.*

Eritrea. *B.S.G. Italiana* **4** (1903): 76–109. **Tancredi.**

Sul clima di Addi-Ugri (Colonia Eritrea). Nota del capitano A. M. Tancredi.

French Congo. **Morel.**

The British Case in French Congo. The Story of a Great Injustice, its Causes, and its Lessons. By Edmund D. Morel. London: W. Heinemann, 1903. Size 8 × 5, pp. xxii. and 216. *Map. Price* 6*s.*

French Congo—Ogowe. *Ann. G.* **12** (1903): 159–171. **Haug.**

Le Bas Ogooué, notice géographique et ethnographique. Par E. Haug. *With Map.*

The various interlacing arms of the Ogowe, and the lakes communicating with them, are shown on the map on the large scale of 1 : 250,000.

German East Africa. **Adams.**

Lindi und sein Hinterland. Von P. Adams. Berlin: D. Reimer, (N.D.). Size 9½ × 6½, pp. 72. *Maps and Illustrations. Price* 1*s.* 6*d.*

German South-West Africa. **Hartmann.**

Beiträge Kolonialpolitik 4 (1902–1903): 399–430.

Meine Expedition 1900 ins nördliche Kaokofeld und 1901 durch das Amboland. Von Dr. G. Hartmann. *With Illustrations.* [See note, *ante*, p. 331.]

Hausa Language. **Brooks and Nott.**

Bátū na Abūbuan Hausa. With Translation, Vocabulary and Notes. By W. H. Brooks and Lewis H. Nott. London: Henry Frowde, 1903. Size 7½ × 5, pp. 56. *Price* 3*s.* 6*d. net. Presented by the Publishers.*

Short writings by a Hausa on Hausa customs and industries.

Ivory Coast. *Ann. G.* **12** (1903): 145–158. **Cassel.**

Géographie économique de la Haute Côte d'Ivoire Occidentale. Par C. Van Cassel. *With Map.*

Ivory Coast and Liberia. *Ann. G.* **12** (1903): 130–144. **d'Ollone.**

Côte d'Ivoire et Libéria. Variations cartographiques relatives à ces contrées et état actuel de nos connaissances. Par le capitaine d'Ollone. *With Maps.*

Kamerun. *Globus* **83** (1903): 284–285. **Schkopp.**

Zwergvölker in Kamerun. Von E. v. Schkopp.

Madagascar. *La G., B.S.G. Paris* **7** (1903): 278–283. **Gallieni.**

Diégo Suarez. La Route de la Montagne d'Ambre. Par Général Gallieni.

Madagascar. ———

Guide-Annuaire de Madagascar et Dépendances, Année 1903. Tananarive, 1903. Size 9 × 6, pp. x. and 846. *Maps and Plates. Presented by the French Colonial Office.*

Mauritius. **Anderson.**

Esquisse de l'Histoire du Protestantisme à l'Ile Maurice et aux Iles Mascarègnes 1505 à 1902. Thèse par J. F. Anderson. Paris: Société Française d'Imprimerie et de Libraire, 1903. Size 10 × 6½, pp. 96. *Map and Illustrations. Presented by the Author.*

Morocco. *Ann. G.* **12** (1903): 120–129. **Segonzac.**

Voyages au Maroc (1899–1901). Par le Marquis de Segonzac.

Niger. **Lenfant.**

Capitaine Lenfant. Le Niger voie ouverte à notre Empire Africain. Préface par M. E. Étienne. Introduction du Colonel Peroz. Paris: Hachette & Cie., 1903. Size 10 × 6½, pp. vii. and 256. *Map and Illustrations. Price* 10*s.*

Nile. **Henze.**

Der Nil, seine Hydrographie und wirtschaftliche Bedeutung. Von Dr. H. Henze. (Angewandte Geographie, I. Serie, 4 Heft.) Halle-a.-S., 1903. Size 10 × 6½, pp. 104.

Rhodesia. *Rev. G.* **52** (1903): 421–435. **Maitre.**

North-Eastern Rhodesia. Lobemba et Lobisa. Par H. Maitre. *With Map.*

Cf. Article in *Journal* for July, 1902.

Rhodesia. *Quarterly J. Geolog. S.* **59** (1903): 266–291. **Molyneux.**

The Sedimentary Deposits of Southern Rhodesia. By A. J. C. Molyneux. With Appendices by Dr. A. S. Woodward, Dr. W. Hind, and E. A. N. Arber. *With Map, Sections, and Plate.*

Sahara. **Dürkop.**

Die wirtschafts- und handels-geographischen Provinzen der Sahara, begründet durch nützliche Pflanzen. Inaugural-Dissertation . . . von Erich Dürkop. Wolfenbüttel, 1902. Size 9 × 6, pp. 58.

Sahara—Tawarek. **King.**

A Search for the Masked Tawareks. By W. J. Harding King. London: Smith, Elder & Co., 1903. Size 8½ × 5½, pp. viii. and 334. *Maps and Illustrations. Price* 12*s.* 6*d.* net. *Presented by the Publishers.*

Sokotra. **Kossmat.**

Geologie der Inseln Sokótra, Sémha und 'Abd el Kûri. Von Dr. Franz Kossmat. Wien, 1902. Size 12½ × 9½, pp. 62. *Map and Plates. Presented by the Author.*

Somaliland. **Ferrandi.**

Seconda Spedizione Bòttego. Lugh: Emporio Commerciale sul Giuba. Memorie e note di U. Ferrandi. A cura e spese della Società Geografica Italiana. Roma, 1903. Size 10 × 7, pp. xvi. and 434. *Maps and Illustrations. Price* 12 lire. *Presented by the Italian Geographical Society.*

Somalis. **Ferrand.**

Matériaux d'études sur les pays Musulmans. Les Comâlis, par Gabriel Ferrand. Paris: E. Leroux, 1903. Size 7½ × 5, pp. xiv. and 284. *Price 4s. 6d.*

South Africa. **Diesterweg.**

Aus dem Pionier-Leben während meines 20-jährigen Aufenthaltes in Süd Afrika. Von Moritz Diesterweg. Burg.: A Hopfer, 1902. Size 8½ × 5½, pp. viii. and 227. *Map and Illustrations. Price* 3 *m. Presented by the Publishers.*

Sudan. *C. Rd.* **136** (1903): 1118–1120. **Lapparent.**

Sur les traces de la mer lutétienne au Soudan. Note de M. de Lapparent.

Cf. note in Monthly Record for August.

Sudan. *B.S.G. Lille* **39** (1903): 414–443. **Meynier.**

La France dans l'Afrique Centrale. Mission Joalland-Meynier. Par le Capitaine Meynier. *With Map.*

Tripoli. **Mathuisieulx.**

À Travers la Tripolitaine. Par H. M. de Mathuisieulx. Préface de M. L. Bertrand. Paris: Hachette & Cie, 1903. Size 7½ × 4½, pp. vii. and 302. *Illustrations. Price* 4 *fr. Presented by the Publishers.*

Uganda. **Woodward.**

Précis of Information concerning the Uganda Protectorate. Compiled in the Intelligence Division, War Office. By Brevet-Major E. M. Woodward. London, 1902. Size 9½ × 6, pp. 160. *Maps. Price 5s. 6d. Presented by the Intelligence Division, War Office.*

A useful summary of our knowledge of the Uganda protectorate, with hints as to outfit, etc. There is a large-scale map (10 miles to an inch) in four sheets, but this was prepared in 1900, and is consequently not quite up-to-date.

West Africa—Cotton. **Baillaud.**

Renseignements Colon., Comité l'Afrique Francaise **2** (1903): 37–44.

L'exploitation du Coton en Afrique occidentale. Par E. Baillaud.

NORTH AMERICA.

Alaska. **Brooks.**

Preliminary Report on the Ketchikan Mining District, Alaska, with an Introductory Sketch of the Geology of South-Eastern Alaska. By A. H. Brooks. (Dep. of the Interior, United States Geological Survey. Professional Paper, No. 1.) Washington, 1902. Size 11½ × 9, pp. 120. *Maps. Presented by the U.S. Geological Survey.*

Canada. *Monthly Rev.* **11** (1903): 91–108. **Haultain.**

Who should Emigrate to Canada? By T. A. Haultain. *With Illustrations.*

Canada—Nova Scotia. **Ells.**

P. and T. Nova Scotian I. Sci. **10** (1901–1902): 433–446.

The Progress of Geological Investigation in Nova Scotia. By Dr. R. W. Ells.

Canada—Rocky Mountains. *Appalachia* **10** (1903): 142–165. **Outram.**

Climbs among the Highest Canadian Rockies: Mounts Columbia, Lyell, Bryce, and others. By J. Outram. *With Plates.*

Canada—Rocky Mountains and Selkirks. *Appalachia* **10** (1903): 179–186. ——

Bibliography of the Rocky Mountain and Selkirk Ranges: British Columbia and Alberta.

Canada—Selkirk Range. *Appalachia* **10** (1903): 123–135. **Wheeler.**

Behind the Asulkan and Donkin Passes. By A. O. Wheeler. *With Map and Plates.*

Mexico—Popocatepetl. *Deutsch. Rundschau G.* **25** (1903): 433–439. **Lemcke.**

Eine Besteigung des Vulkans Popocatepetl in Mexiko. Von H. Lemcke. *With Illustrations.*

United States. **Bennett.**
Trade, Agriculture, etc., of the States of California, Nevada, Utah, and Arizona for the year 1902. Foreign Office, Annual No. 2988, June, 1903. Size 9½ × 6, pp. 60. *Price* 3*d.*

United States—Blue Ridge. *B.G.S. Philadelphia* **3** (1903): 213–244. **Davis.**
The Stream Contest along the Blue Ridge. By W. M. Davis. *With Illustrations.*

United States—Kansas. *J.G.* **2** (1903): 155–158. **Hollister.**
A curious Salt Pond in Kansas. By G. B. Hollister. *With Illustrations.*

United States—Meteorology. *J.G.* **2** (1903): 124–136. **Burrows.**
The Chinook Winds. By A. T. Burrows. *With Diagrams.*

United States—Minnesota. **Hall.**
Geography and Geology of Minnesota. Vol. i. Geography of Minnesota. By Christopher Webber Hall. Minneapolis: H. W. Wilson Company, 1903. Size 7½ × 5, pp. xii. and 300. *Maps and Illustrations. Presented by the Publishers.*

United States—New Jersey. **Harshberger.**
P.A. Nat. Sci. Philadelphia **54** (1902): 642–669.
Additional Observations on the Strand Flora of New Jersey. By J. W. Harshberger.

United States—New York. *J.G.* **2** (1903): 115–124. **Carney.**
A Type Case in Diversion of Drainage. By F. Carney. *With Maps and Illustrations.*

United States—North Carolina. **Weaver.**
Internal Improvements in North Carolina previous to 1860. By C. C. Weaver, PH.D. (Johns Hopkins University Studies. Series xxi. Nos. 3–4.) Baltimore, 1903. Size 10 × 6, pp. 96.
Rivers, canals, and railways are treated of in turn.

United States—Texas. *T. Texas A. Sci.* **4** (1901): pp. 4 and 8. **Dumble.**
The Red Sandstone of the Diabolo Mountains, Texas. Cretaceous and Later Rocks of Presidio and Brewster Counties. By E. T. Dumble.

United States—Texas. *T. Texas A. Sci.* **3** (1899): 17–296. **Simonds.**
A Record of the Geology of Texas for the Decade ending December 31, 1896. By Dr. F. W. Simonds.

United States—Texas. *T. Texas A. Sci.* **4** (1901): pp. 48. **Taylor.**
The Water Power of Texas. By T. U. Taylor. *With Illustrations.*

United States—Texas. *T. Texas A. Sci.* **4** (1900): 59–80. **Thompson.**
The Development of the present Texas Railway System. By R. A. Thompson.

CENTRAL AND SOUTH AMERICA.

Argentine Republic. *B.A. Nac. Ci. Cordoba* **17** (1902): 203–261. **Bodenbender.**
Contribucion al conocimiento de la precordillera de San Juan, de Mendoza y de las sierras centrales de la República Argentina. Por G. Bodenbender. *With Sections.*

Argentine Republic. **Nordenskiöld.**
Präcolumbische Wohn- und Begräbnisplätze an der Süd-Westgrenze von Chaco. Von E. Nordenskiöld. (K. Svenska Vetenskaps-Akademiens Handlingar. Bandet 36, No. 7.) Stockholm: P. A. Norstedt & Söner, 1903. Size 12 × 9½, pp. 22. *Map and Illustrations. Presented by the Author.*

Argentine Republic. *B. American G.S.* **35** (1903): 130–143. **Smith.**
The Economic Geography of the Argentine Republic. By J. R. Smith. *With Map.*

Bolivia. *B. Oficina Nac. Inmigración, etc., La Paz* **2** (1902): 815–818. **Varnoux.**
Descripcion fisica de la cadena de Apolobamba. Por L. Varnoux.

Bolivia. *B. Oficina Nac. Inmigracion, etc., La Paz* **2** (1902): 753–780. ——
El primer censo decenal de la poblacion de Bolivia. Sus resultados generales. Censo del Departamento de Santa-Cruz.

Bolivia—Acre. **Medina.**

Angel Diaz de Medina. La Cuestion del Acre. El Derecho Boliviano y la Circular de Sr. Baron de Rio Branco. La Paz, 1903. Size 8 × 5½, pp. 57. *Map. Presented by Sr. M. V. Ballivian.*

Bolivia—Desaguadero. ——

B. Oficina Nac. Inmigración, etc., La Paz **2** (1902): 787–789.

La Navegacion del Desaguadero.

Brazil and Argentine Republic. **Barclay.**

To the falls of the Iguazú. By William S. Barclay. Buenos Aires. The South American Bank Note Co., 1903. Size 10½ × 7, pp. 48. *Map and Illustrations. Two Copies. Presented by the Author.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australia. *B.S.G. Italiana* **4** (1903): 204–917. **Grasso.**

Australiani indigeni ed Australiani britannici di fronte alle svantaggiose condizioni geografiche del loro continente. Appunti statistici del prof. G. Grasso.

Contrasts the development of Australia by civilized man with the backward conditions which prevailed under its native inhabitants.

Australia. **Moore.**

Moore's Australian Almanac and Country Directory for the year 1903. Sydney: Kealy & Philip. Size 7½ × 5, pp. xvi., 152, and 182.

Australia—Geology. **Thomson.**

The Physical Geography of Australia: V. Geology. By J. P. Thomson. (Reprinted from *Proceedings and Transactions of the R.G.S. of Australasia, Queensland*, vol. xviii.) Size 10 × 6, pp. 32. *Presented by the Author.*

Caroline Islands. *Deutsch. Kolonialblatt* **14** (1903): 364–366. **Berg.**

Bericht des Vizegouverneurs Berg über einen Besuch der Trukinseln (Ostkarolinen).

Gilbert Islands. *Records Australian Museum* **5** (1903): 1–15. ——

Notes on the Zoology of Paanopa or Ocean Island and Nauru or Pleasant Island, Gibert Group.

New Zealand—Chatham. *Globus* **83** (1903): 325–326. **Schurtz.**

Die Herkunft der Moriori. Von Dr. Heinrich Schurtz.

The late Dr. Schurtz's researches have confirmed the native tradition, and shown that the Morior are a Polynesian race akin to the Maori, but exhibiting a further mixture with the aboriginal dark race of this region.

Ocean Island. *Geolog. Mag.* **10** (1903): 2 8–300. **Reed.**

Notes on Ocean Island (Banaba). By F. R. Cowper Reed.

Queensland. **Dixon.**

Queensland. Department of Mines. Index No. 2 to Names of Places, Mines, Reefs, etc., occurring in the Geological Survey Reports, Queensland, Nos. 136 to 177 (inclusive) By Russell Dixon. Brisbane: G. A. Vaughan, 1902. Size 10 × 6, pp. 38.

Samoa—Climate. *Ann. Hydrographie* **31** (1903): 193–204. **Burchard.**

Das Klima von Apia (Samoa-Inseln) nach 10 jährigen meteorologischen Aufzeichnungen von Dr. Funk dargestellt von Dr. O. Burchard.

South Australia. ——

1899. Meteorological Observations, made at the Adelaide Observatory and other places in South Australia and the Northern Territory during the year 1899, under the direction of Charles Todd. Adelaide: C. E. Bristow, 1902. Size 13 × 8, pp. xvi., 96, and 92. *Charts. Presented by the Government Astronomer, Adelaide Observatory.*

Torres Straits. ——

Reports of the Cambridge Anthropological Expedition to Torres Straits. Volume ii. Physiology and Psychology. Part i. Introduction and Vision. Part ii. Hearing, Smell, Taste, Cutaneous Sensations, Muscular Sense, Variations of Blood-pressure, Reaction-Times. Cambridge: University Press, 1901–3. Size 11½ × 9, pp. vi. and 1–224. *Maps. Price, Part i., 9s. net; Part ii., 7s. net. Presented by the Syndics of the Cambridge University Press.*

POLAR REGIONS.

Antarctic—Expeditions. *Scottish G. Mag.* **19** (1903): 370-376. ——

The Antarctic Expeditions. *With Charts.*

Arctic—Abruzzi Expedition. *Tour du Monde* **9** (1903): 145-228. **Prior.**

L'Étoile Polaire dans la Mer Arctique (1899-1900). Par S. A. R. le Duc des Abruzzes. Traduit et résumé par H. Prior. *With Maps and Illustrations.*

Arctic—Abruzzi Expedition. **Ricchieri.**

Prof. Giuseppe Ricchieri. La *Stella Polare* nel Mare Artico. Relazione sui risultati della spedizione di S. A. R. il Duca degli Abruzzi. Messina, 1903. Size 9½ × 6½, pp. 80. *Presented by the Author.*

Arctic—Baldwin-Ziegler Expedition. **Baldwin.**

Wide World Mag. **10** (1903): 396-402, 432-436, 587-593.

The Baldwin-Ziegler Polar Expedition. By E. Briggs Baldwin. *With Illustrations.*

Arctic—Ice Conditions. **Garde**

The State of the Ice in the Arctic Seas, 1902. Prepared by V. Garde. (Special print of the nautical-meteorological annual of the Danish Meteorological Institute.) Size 12½ × 9½, pp. xxii. *Maps.*

Arctic—Ice and Navigation. *Izvestiya Imp. Russ. G.S.* **38** (1902): 306-341. **Varnek.**

Distribution of Ice and the Condition of the Navigation to Siberia. By A. T. Varnek. [In Russian.] *With Maps.*

This has been noticed in the Monthly Record.

Arctic—Russian Expedition. **Kolomeitsoff.**

Izvestiya Imp. Russ. G.S. **38** (1902): 342-369.

The Russian Polar Expedition of Baron Toll. By N. N. Kolomeitsoff.

MATHEMATICAL GEOGRAPHY.

Astronomy. *Ann. Hydrographie* **31** (1903): 211-222. **Wedemeyer.**

Zur Höhenberechnung. Von A. Wedemeyer.

Cartography. *J.S. Arts* **51** (1903): 552-563. **Morrison.**

The Construction of Maps and Charts. By G. J. Morrison. *With Diagrams.*

Latitudes and Longitudes. ——

Accessions (No. vii.) to collection of Latitudes and Longitudes. Map Room. Intelligence Division, W.O. December, 1902. Size 12½ × 10, pp. 42.

Navigation. *B.S.G. Italiana* **4** (1903): 119-132. **Roncagli.**

Per la definizione della Lossodromia. Note esplicative del Comandante G. Roncagli.

Navigation. ——

On the Station Pointer and the manner of fixing a Ship's Position by its aid. Second Edition. London: J. D. Potter, 1903. Size 8½ × 5½, pp. 10. *Diagrams. Price* 6*d*. *Presented by the Hydrographer, Admiralty.*

Navigation. *B.S.G. Italiana* **4** (1903): 259-262. **Porena.**

Per la definizione della lossodromia. Del prof. F. Porena.

Surveying. **Duplessis.**

Traité du Nivellement, comprenant les Principes Généraux, la description et l'usage des Instruments, les Opérations et les Applications. Par J. Duplessis. Troisième édition. Paris. C. Béranger. 1903. Size 9 × 5½, pp. xiv. and 342. *Diagrams. Price* 8*s*. 6*d*.

Surveying. *M.K.K. Militär-G.I.* **22** (1902): 139-154. **Hübl.**

Die Stereophotogrammetrie. Von A. Freiherrn von Hübl.

Surveying. *M.K.K. Militär-G.I.* **22** (1902): 41-109. **Weixler.**

Directiven zur Ausgleichung trigonometrischer Messungen auf analytischgeometrischer Grundlage. Verfasst und mit Beispielen erläutert von A. Weixler. *With Diagram.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geophysics. **Ekman.**
Om jordrotationens inverkan på vindströmmar i hafvet. Af V. W. Ekman. Stockholm, 1902. Size 9½ × 6, pp. 28.

Geophysics. *C. Rd.* **136** (1903): 1172–1173. **Lippmann.**
Sur la distribution de la matière à la surface de la Terre. Note de G. Lippmann.

Gravity Determination. **Hecker.**
Bestimmung der Schwerkraft auf dem Atlantischen Ozean sowie in Rio de Janeiro, Lissabon und Madrid. Von O. Hecker. (Veröffentlichung des Königl. Preussischen Geodätischen Institutes, N.F. No. 11.) Berlin: P. Stankiewicz, 1903. Size 11½ × 9, pp. vi. and 138. *Plates.*

Hydrology. *C. Rd.* **136** (1903): 1511–1517. **Boussinesq.**
Sur le débit, en temps de sécheresse, d'une source alimentée par une nappe d'eaux d'infiltration. Note de J. Boussinesq.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Commerce. *B.S.G. Com. Paris* **25** (1903): 97–108. **Barthélemy.**
Les points stratégiques commerciaux. Par M. le Marquis de Barthélemy.

Æneas Sylvius. **Berg.**
Enea Silvio de' Piccolomini (Papst Pius II.) in seiner Bedeutung als Geograph. Ein Beitrag zur Geschichte der Erdkunde im Quattrocento. Inaugural-Dissertation . . . von Alfred Berg. Halle-a.-S., 1901. Size 9 × 6, pp. 46.

Historical—Chinese Explorer. *Globus* **83** (1903): 293–294. **Stenz.**
General Tschan-t'chien, ein chinesischer Forschungsreisender des zweiten Jahrhunderts. Von P. G. M. Stenz.

Historical – St. Helena. *Blackwood's Mag.* **173** (1903): 621–633. **Clifford.**
The Earliest Exile of St. Helena. By Hugh Clifford, C.M.G.
The exile referred to is Fernão Lopez, a renegade who was left on St. Helena early in the sixteenth century.

Historical—Toscanelli and Columbus. **Markham and Vignaud.**
Toscanelli and Columbus. A Letter from Sir Clements R. Markham and a Reply from Mr. Henry Vignaud. London: Sands & Co., 1903. Size 10 × 6½, pp. 40.

Historical—Toscanelli and Columbus. *B.S.R. Belge G.* **27** (1903): 158–176. **Mees.**
La lettre de Toscanelli à Christophe Colomb. Par Dr. J. Mees.

Historical Geography. *Ann. G.* **12** (1903): 172–175. **Girardin.**
Sur un projet de Corpus topographique du monde ancien. Par P. Girardin.
On a proposed dictionary of ancient place-names and geographical terms down to 1200 A.D.

Political Geography—Boundaries. *B. American G.S.* **35** (1903): 147–159. **Russell.**
Geography and International Boundaries. By I. C. Russell.

Telegraph Cables. *Rev. Française* **28** (1903): 207–230, 261–286. **Gamard.**
Les Cables télégraphiques sous-marins. Par L. Gamard.

Telegraph Cables. *Rev. G.* **52** (1903): 436–450. **Brisse.**
Le réseau mondial de câbles sous-marins. Par A. Brisse. *With Map.*

BIOGRAPHY.

Jankó. *Deutsch. Rundschau G.* **25** (1903): 471–473. **Thirring.**
Dr. Johann Jankó. Von Dr. G. Thirring. *With Portrait.*

Livingstone. *Deutsch. Rundschau G.* **25** (1903): 403–406. **Dürr.**
David Livingstone. (Zur Erinnerung an die dreissigjährige Wiederkehr seines Todestages.) Von L. Dürr.

GENERAL.

Berlin Geographical Society. **Hellmann.**

Verh. Ges. Erdk. Berlin, N.S. **2** (1903): 328-343.

Fest-Sitzung zur Feier des 75-jährigen Bestehens der Gesellschaft für Erdkunde zu Berlin am 4 Mai, 1903. Ansprache des Vorsitzenden.

See note, *ante*, p. 219.

Educational. *G. Teacher* **2** (1903): 48-66. **Morgan.**

The Scope and Practical Teaching of Geography in Schools. By Dr. A. Morgan. *With Illustrations.*

Educational. **Reclus.**

L'Enseignement de la Géographie. Par Élisée Reclus. (Extrait du No. 1 [1903] du *Bulletin de la Société Belge d'Astronomie.*) Bruxelles. Size 10 × 6½, pp. 10. *Presented by the Institut Géographique, Brussels.*

Encyclopædia Britannica. ———

An Index to the complete Encyclopædia Britannica, being the Eleventh of the New Volumes which constitute, in conjunction with the Existing Volumes of the Ninth Edition, the Tenth Edition of that work. Volume xxxv. of the complete work. London, 1903. Size 12½ × 9, pp. 1092.

German Colonies. **Buchanan.**

Report for the year 1901-02 on the German Colonies. Foreign Office, Annual No. 2983, 1903. Size 10 × 6½, pp. 30. *Price* 2*d.*

German Colonies. ———

Denkschrift über die Entwickelung der deutschen Schutzgebiete in Afrika und der Südsee, Berichtsjahr 1. April 1901 bis 31. März 1902. Ditto. Anlagen. Size 12 × 9, pp. 122, 432.

German Colonies. ———

Die deutsche Kolonial-Gesetzgebung. Sammlung der auf die deutschen Schutzgebiete bezüglichen Gesetze, Verordnungen, Erlasse und internationalen Vereinbarungen mit Anmerkungen, Sachregister. Sechster Teil, 1901 bis 1902. Berlin: E. S. Mittler u. Sohn, 1903. Size 9½ × 6½, pp. xxii. and 674. *Price* 13*s.* 6*d.*

Index. **Scherman.**

Register zu den Jahresberichten der Geographischen Gesellschaft in München, 1871-1902. Bearbeitet von dem derzeitigen Bibliothekar, Prof. Dr. L. Scherman. Size 9 × 6, pp. 56. *Presented by the Author.*

Portuguese Colonies. **Vasconcellos.**

As Colonias Portuguezas. Geographia Physica, Politica e Economica. Por Ernesto J. de C. e Vasconcellos. 2ª Edição correcta e augmentada. Lisboa, 1903. Size 8 × 5½, pp. 472. *Maps. Presented by the Author.*

The first edition of this useful work appeared in 1896. It has now been revised and brought up to date.

Topography. **Lébédev.**

Codex 286 du Vatican. Récits de Voyages d'un Arabe. Traduction de l'Arabe par M^me^ Olga de Lébédev. St. Petersbourg, 1903. Size 10½ × 7, pp. 106 and ii. *Price* 3*s.*

Contains descriptions of Jerusalem, Rome, and other cities.

Travel. **Del Mar.**

Around the World through Japan. By Walter Del Mar. London: A. & C. Black, 1903. Size 9 × 5½, pp. xviii. and 434. *Illustrations. Price* 18*s. Presented by the Publishers.*

Year-book. **Haack and others.**

Geographen-Kalender. In Verbindung mit Dr. Wilhelm Blankenburg, Prof. Paul Langhans, Prof. Paul Lehmann und Hugo Wichmann herausgegeben von Dr. Hermann Haack. Erster Jahrgang 1903-1904. Gotha: Justus Perthes, 1903. Size 6½ × 4, pp. xxi., 320, and 124. *Portrait. Presented by the Publishers.*

A most useful work of reference, including kalendar with geographical tables, sections on the events of the year in the field of geography and world-politics, statistical information on the various countries, and the names and addresses of geographers throughout the world.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Central Europe. **Liebenow and Ravenstein.**

Liebenow-Ravenstein's Special-Radfahrerkarte von Mittel-Europe. Scale 1: 300,000 or 4·7 stat. miles to an inch. Sheets: 42, Alkmaars; 55, Amsterdam; 115, Nürnberg; 128, Stuttgart; 129. Ingolstaat; 140, Colmar; 141, Freiburg; 142, Ulm. Frankfurt-a-M.: Ludwig Ravenstein, 1903.

Dolomite Alps. **Freytag.**

G. Freytag's Touristen-Wanderkarte der Dolomiten (Östliches Blatt) mit markierten Wegen. Scale 1: 100,000 or 1·5 stat. mile to an inch. Vienna and Leipzig: G. Freytag & Berndt. *Presented by the Publishers.*

A tourists' map, showing principal roads and paths in red. It is printed in colours, and the relief is very effectively shown by shading.

England and Wales. **Ordnance Survey.**

ORDNANCE SURVEY OF ENGLAND AND WALES:—Sheets published by the Director-General of the Ordnance Survey, Southampton, from July 1 to 31, 1903.

4 miles to 1 inch:—

Hill-shaded map, printed in colours, in sheets, 15, 18. 1*s.* 6*d. each.*

1 inch:—

Printed in colours, 78, 80, 81 and 82 (combined), 92 and 93 (combined). 1*s.* each.

(First revision) with hills in brown or black, 28, 37, 47, 48, 49, 53, 54, 55, 58, 60, 62, 63, 64, 68, 70, 71. 1*s. each* (engraved).

(Second revision) in outline, 1, 2, 4, 5, 317, 331, 332, 333, 344, 345. 1*s. each* (engraved).

6-inch—County Maps (first revision):—

Cambridgeshire, 31 S.E., 42 N.W.. 53 N.E., 54 S.W., 55 S.E., 57 N.E., 58 N.W. **Cardiganshire,** 13 S.W. **Dorset,** 11 S.E., 21 N.E., 30 N.E., 58 N.W., N.E., S.E. **Gloucestershire,** 15 S.E., 25 S.W., 27 S.E., 30 S.W., 31 S.E., 34 N.W., N.E., S.E., 38 S.E., 42 S.E., 43 N.W., N.E., S.E., 45 N.W., S.W., 46 N.E., S.W., 53 S.W., 54 N.E., 54 S.W., 60 N.W., 62 S.W., S.E. **Montgomeryshire,** 31 S.W., 36 S.E., 37 S.W.. 38 N.W., N.E., 43 S.W., S.E., 44 N.E., S.E., 47 S.W., 48 N.E., S.W., S.E., 49 N.E.. 51 S.W., 52 N.E. **Radnorshire,** 1 S.E., 3 N.E., S.W., S.E., 4 N.E., 7 S.W., 8 N.E. **Shropshire,** 2 S.E., 9 S.E., 24 S.W., 36 S.E., 47 S.W., 51 S.E., 52 N.W., 54 N.W., N.E., 57 N.E., 58 N.W.. N.E., 59 N.E., 61 N.E., S.E. **Staffordshire,** 49 N.W., N.E., 63 N.E. **Suffolk,** 42 N.W. **Warwickshire (Det.),** 53 N.E. **Wiltshire,** 5 N.W. **Worcestershire and Do. (Det.** 3, 4, and 6), 8 S.E., 51 N.E., 58 S.E. **Yorkshire** (first revision of 1890 survey), 287 N.W., 290 S.E., 291 N.W., S.W., S.E., 296 S.W., S.E., 300 S.E. 1*s. each.*

25-inch—County Maps (first revision):—

Cambridgeshire, LVIII. 12; **Dorset,** XI. 6; XIX. 8, 9, 10; XX. 2; XXIX. 2, 10; XXXVII. 1. **Gloucestershire,** XVI. 3, 4, 8, 16; XXIII. 16; XXIV. 1; XXVI. 3, 12; XXXI. 8; XLV. 2, 3, 14; XLVII. 11; LIII. 3; LXV. 9; LXVII. 3, 10, 11, 12, 14, 15, 16; LXX. 5. **Leicestershire,** XI. 8; XII. 6, 11; XVI. 16; XVII. 11, 15; XXIII. 7; XXVIII. 10; XXIX. 7, 13; XXX. 7; XXXIV. 4, 8; XXXV. 3, 8, 9; XXXVI. 2, 3, 5, 7, 10, 14; XLIII. 3, 14, 15; XLVIII. 3, 7. **Radnorshire,** IV. 13; V. 5; XV. 11; XVI. 1, 2, 5, 10. **Shropshire,** LXVIII. 5; LXX. 13; LXXII. 13, 14; LXXIII. 9; LXXVI. 4, 8; LXXVII. 5; LXXVIII. 2, 4; LXXX. 5. **Somerset.** VI. 9, 14; IX. 11, 12, 15; X. 1, 13, 15, 16; XII. 5; XVI. 7; XVII. 4, 7, 15; XLV. 3, 11; XLVI. 9; LXIII. 12; LXV. 2; LXXII. 4, 10; LXXIII. 5, 6; LXXIV. 11; LXXX. 3; LXXXI. 10, 12; LXXXII. 14; LXXXIX. 9; XC. 1, 6; XCII. 1, 2, 3, 4, 6, 8, 9, 10; XCIII. 2. **Staffordshire,** LXI. 7, 16; LXIII. 13, 14; LXVI. 3; LXX. 2; **Suffolk,** LXXXIII. 16; LXXXIV. 9, 10, 13, 14; LXXXIX. 4, 7, 8; XC. 1, 2, 5. **Warwickshire,** III. 10, 13; IV. 11; V. 9, 16; IX. 15; X. 9, 10. 3*s. each.*

4 miles to 1 inch—Miscellaneous Maps:—

Manœuvre Map, South of England (parts of sheets 15, 19, and 23), 2*s.*, mounted on linen, flat in sheets or folded in covers (boundary printed in colour).
(*E. Stanford, London Agent.*)

England and Wales. **Gall and Inglis.**

The "Strip" Route Maps. Scale 1 : 127,260 or 2 stat. miles to an inch. Nos. : 5, The Exeter Road; 19, The Liverpool and Manchester Roads; 21, The Carlisle Road. Edinburgh and London: Gall & Inglis. *Price* 1*s. each. Presented by the Publishers.*

These form Nos. 5, 19, 21 of Gall and Inglis' series of "Strip" Route-maps, and will doubtless prove useful to tourists travelling by motor or cycle. They show the main roads in brown, and a few miles of the country on either side. A vertical section is given by the side of the road, showing distances and the rise and fall of the ground.

ASIA.

Korea. **Kotô.**

Korea. Scale 1 : 2,000,000 or 31·5 stat. miles to an inch. Compiled and transliterated by B. Kotô, PH D. Tokyo: Maruya & Co., Ltd., 1903. *Presented by Dr. B. Kotô.*

This map is printed in colours, the hills being shown in brown shading, lowlying land lined in green, and water blue. It shows no details, and comparatively few names. The spelling of the names is according to the system of Dr. Kotô, the author, a professor of Tokyo University.

AFRICA.

Liberia. **de Morny and Okie.**

Map of the St. Paul River and vicinity, Montserrado County, Liberia. Made from a Prismatic Survey and Notes of the expedition of M. le duc de Morny and Howard Okie, Esq., 1902–3. Scale 1 : 633,600 or 10 stat. miles to an inch. *Presented by Howard Okie, Esq.*

The route here shown extends from Monrovia, on the coast, for about 250 miles into the interior, and follows approximately the course of the St. Paul river. The map extends for a considerable distance further to the north, but this part is merely roughly sketched in. No latitudes or longitudes are given, and the map can only be considered as a preliminary compass sketch, without any attempt at great accuracy. However, as little survey work of any kind has been done in Liberia, any addition to our knowledge of the country is important.

AMERICA.

Brazil. **Jerrmann.**

Das Quellgebiet des Rio Paraguay. Von Kapitän Ludwig Jerrmann. Scale 1 : 400,000 or 6·3 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1903, Tafel 13. Gotha: Justus Perthes. *Presented by the Publisher.*

Canada. **Surveyor-General of Canada.**

Sectional Map of Canada. Scale 1 : 190,080 or 3 stat. miles to an inch. Wood Mountain Sheet (49), West of Third Meridian. Revised to June 1, 1903. Tramping Lake Sheet (61), West of Third Meridian. Revised to May 19, 1903. Edmonton Sheet (79), West of Fourth Meridian. Revised to June 9, 1903. Ottawa: Surveyor-General's Office, 1903. *Presented by the Surveyor-General of Canada.*

Mississippi River. **Mississippi River Commission.**

Survey of the Mississippi River, made under the direction of the Mississippi River Commission. Lake Itasca Basin within Itasca State Park. Projected from a trigonometrical survey made in 1900. Scale 1 : 15,000 or 4·2 inches to a mile. St. Louis, [1903]. *Presented by W. G. Comber, Esq.*

The triangulation, levels, topographical, and hydrographical work upon which this map is based were carried out under the direction of Captain Mason M. Patrick, Corps of Engineers, U.S.A., and Captain G. P. Howell, Corps of Engineers, U.S.A., secretaries of the Mississippi River Commission. Latitudes and longitudes are derived geodetically from the Cairo Astronomical station, determined in 1876 by Captain H. M. Adams, Corps of Engineers, U.S.A., and First Lieut. D. W. Lockwood, Corps of Engineers, U.S.A. Elevations are given in feet above the Memphis datum plane, and the contour-lines, in brown, are 5 feet apart. The soundings in the lake were measured at low water, the rise and fall of the lake being about 1·3 foot. The map is specially interesting from the fact that it includes the headwaters of the Mississippi.

North America. **McGee.**

Karte der Fall-Linie des östlichen Nord-Amerika nach W J McGee. Scale 1 : 5,702,400 or 90 stat. miles to an inch. With sections. *Vierteljahrshefte für*

den geographischen Unterricht, II. Jahrgang, Heft 3. Vienna: Ed. Hölzel, 1903. *Presented by the Publisher.*

United States. **Blum.**

Kärtchen der Vereinigten Staaten. Von Richard Blum. Scale 1: 12,500,000 or 197·2 stat. miles to an inch, and 1: 30,000,000 or 473·4 stat. miles to an inch. *Petermanns Geographische Mitteilungen Ergänzungsheft*, No. 142. Gotha: Justus Perthes. *Presented by the Publisher.*

AUSTRALASIA.

Australasia. **Robinson.**

Australasia. Scale 1: 5,702,400 or 81 stat. miles to an inch. By H. E. C. Robinson. Sydney: H. E. C. Robinson. *Presented by the Publisher.*

A somewhat roughly executed wall-map of Australasia, in two sheets. In places the hill-work is confused, and the names obscured by hill-shading. Political divisions are clearly indicated by colours.

Queensland. **Dunstan and Fox.**

Geological Sketch-map of Queensland. Prepared under the supervision of B. Dunstan, F.G.S., Acting Government Geologist, and compiled by H. W. Fox at the Geological Survey Office, Brisbane. Scale 1: 1,267,200 or 20 stat. miles to an inch. Brisbane: Geological Survey Office, 1902. *Presented by the Geological Survey of Queensland.*

This map has been compiled from surveys and reports by Messrs. Clarke, Stutchbury, Aplin, Daintree, Gregory, Jack, Rands, Maitland, Skertchly, Dunstan, and others. It contains a clear explanation of the colours employed to denote the various formations, and other tabular matter.

POLAR REGIONS.

Polar Regions. **Isachsen.**

Die Wanderungen der östlichen Eskimo. Von Gunnar Isachsen. Scale 1: 6,000,000 or 94·6 stat. miles to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1903, Tafel 14. Gotha: Justus Perthes. *Presented by the Publisher.*

GENERAL.

Portuguese Colonies. **Ministerio da Marinha e Ultramar.**

Atlas Colonial Português. Edição reduzida. Ministerio da Marinha e Ultramar. Commissão de Cartographia, 1903.

A small general atlas of the Portuguese colonial possessions. It consists altogether of ten sheets of maps and plans which have been reduced from larger scale-maps by photo-lithography. The style of production is decidedly rough, and some of the maps are on too small a scale to be of much service.

CHARTS.

North Atlantic Ocean and Mediterranean Sea. **Meteorological Office.**

Pilot Chart of the North Atlantic and Mediterranean for August, 1903. London: Meteorological Office. *Price* 6*d. Presented by the Meteorological Office, London.*

United States Chart. **United States Hydrographic Office.**

Pilot Chart of the North Atlantic Ocean for July, 1903, and of the North Pacific Ocean for August, 1903. U.S. Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Ceylon. **Sternberg.**

One hundred and sixty-two Photographs of Ceylon, taken by F. Sternberg, Esq. *Presented by F. Sternberg, Esq.*

An interesting little set of photographs, of which the following are the titles:—(1) A street in Colombo; (2) Museum, Colombo; (3) The lake and washing-place, Colombo; (4) Schoolboys, Colombo; (5) Cingalese, Colombo; (6) A crow, Colombo; (7) General Post Office, Colombo; (8) A chetty, Colombo; (9) A banyan tree, Colombo; (10) Hindu temple, Colombo; (11) Cocoa-nuts and natives; (12) Dutch wall and gate, Negombo; (13) Dutch canal, Negombo; (14 and 15) Fishing-boats, Negombo; (16) Fisherman's huts under palm trees, Negombo; (17) Boys playing cricket, Negombo; (18) Bull, showing brands, Negombo; (19) Kandy, from the Upper Lake walk; (20) Kandy lake and island, from the Upper Lake walk; (21) Ward street, Kandy; (22) Temple of the Tooth, Kandy; (23-25) Lady Horton's walk, Kandy; (26) The pavilion, Governor's residence, Kandy; (27) The reservoir, Kandy; (28) A Cingalese, back

view; (29) A Cingalese, front view; (30) A fruit-seller, Kandy; (31) Buddhist priests, Kandy; (32) Bo tree; (33) "We've been playing rounders;" (34) Bathing-place, Kandy; (35) Public washing-place, Kandy; (36) The road to the river, Kandy; (37) Ferry on the Mahavelli Ganga; (38) Elephants having their bath; (39) "It's so refreshing;" (40) Avenue of Talipot palms; (41) Satinwood bridge; (42) Alu Wihari, Rock Temple, Matale; (43) Frescoes on Rock Temple; (44) Outside the court house, Matale; (45) A headman's wedding party; (46) Group of natives, Matale; (47) Fortune teller, Matale; (48) The coach to Anuradhapura; (49) Village on the road to Anuradhapura; (50) Waiting on the road for the coach to Anuradhapura; (51) Native carrying fowls; (52) Carolina tea estate; (53) The bungalow, Carolina; (54) The Boer camp, Diyatalawa; (55) Last remaining Boer prisoners of war; (56) Boer cemetery; (57) Policeman and sergeant, Bandarawella; (58) The sign-post, Bandarawella; (59) A bungalow near Bandarawella; (60) Interior of verandah of a bungalow; (61) A tea-field, coolies picking; (62) A Canganny; (63) A tea-picker; (64) Coolies returning from picking tea; (65) Weighing up the tea; (66) Some of the workers in the tea factory; (67) Withering tea; (68) An open-air crèche on a tea estate; (69) The Hill Club, Nuivera Eliya; (70) The golf links, Nuivera Eliya; (71) Golf caddies, Nuivera Eliya; (72) The lake, Nuivera Eliya; (73 and 74) Tree ferns in the Hallgalla botanical gardens; (75) Scene in the Hallgalla botanical gardens; (76) Udapusselawa; (77) Fountain and rest-house, Badulla; (78) The square, Badulla; (79) The cross-roads, Badulla; (80) "Buddhism embracing Christianity:" Bo tree which has grown round Mrs. Wilson's tomb, Badulla; (81) Mrs. Wilson's tomb; (82) The post office and staff, Badulla; (83) The hospital, Badulla; (84) The market, Badulla; (85) The town hall, Badulla; (86) Obelisk with Sanscript inscription and ancient sluice; (87) Government buildings, Badulla; (88) A portion of the square, Badulla; (89) A police proclamation; (90) Group of pupils of the Buddhist-English school, Badulla; (91) An Afghan; (92) Tamil woman showing distended lobe of ear; (93) Cingalese, with hackory and coolie carrying box; (94) A pretty landscape; (95) The ingredients used in betel nut, chewing chalk made of shells, tobacco, areca nut, and betel leaves; (96) Coach in which Mr. Sternberg drove from Bandarawella to Ratuapura; (97) A toll-keeper with badge of office; (98) Haldamulla rest-house; (99) Bilihuloya rest-house and large tree; (100) Rural postmen; (101) Paddy field-worker with native-made hoe; (102) Watcher's hut in paddy field; (103) Ploughing paddy field with buffaloes; (104) Ganegama Buddhist temple, near Pelinadulla; (105) Kandyan chief's tomb; (106) A Cingalese woman from the low country; (107) Rest-house, Ratuapura; (108) Principal street, Ratuapura; (109) Government dispensary, Ratuapura; (110) Shelter for natives; (111) A group of natives; (112) Tamil barber shaving Moorman's head; (113) The smithy, Ratuapura; (114) Iak tree, Ratuapura; (115) A Cingalese girl; (116) Mr. Sternberg and his bullock-cart; (117) Gem pit; (118) Gem-diggers; (119) Cutting and polishing gems; (120) A woman worker in paddy field; (121) Ferry on Kalu Ganga; (122) View of river Kalu Ganga; (123) Crew and boat in which Mr. Sternberg went down the Kalu Ganga river from Ratuapura to Kalutura; (124 and 125) Boats on river Kalu Ganga; (126) Kalu Ganga river at Kalutura; (127) A street in Kalutura; (128) Racecourse and cricket ground, Galle; (129) Clock tower on the ramparts, Galle; (130) Dutch gateway and arms, Galle; (131) Old Dutch church, Galle; (132) Interior of old Dutch church; (133) Principal street in native town, Galle; (134) Moormen boys; (135) Lighthouse, Galle; (136) Fishing-boats; (137) A bit of the coast, Galle; (138) Fishermen; (139) A brick-and-tile kilu; (140) Fishermen with nets, Galle; (141) "The oldest inhabitant:" this tortoise belonged to a Dutch governor, and is supposed to be 140 years old; (142) Mr. Sternberg's conveyance, guide, and servant. Anuradhapura; (143) Ruanwelli Dagoba; (144) Frescoes on the Ruanwelli Dagoba; (145) Figure of King Dutugemuna, builder of Ruanwelli Dagoba; (146) Ietewanrama Dagoba; (147) Large figure of Buddha; (148) Ancient Hindu goddess; (149) Yogi stone; (150) Thuparama Dagoba; (151) Entrance to queen's palace; (152) Carved moonstone and steps; (153) Bath; (154) Isurumuniya Rock Temple; (155) Buddhist priest with key of temple; (156) Post office, Anuradhapura; (157) Tamil woman and daughters; (158) Cingalese woman dressed as Tamils; (159) Women pounding rice; (160) Tamil children; (161) Stone railing; (162) Steps at Mahintale.

India. **Knowles.**

One hundred and twenty-two Photographs of the North-West Frontier of India, taken by G. J. F. Knowles, Esq. *Presented by G. J. F. Knowles, Esq.*

A set of small platinotypes of views in the neighbourhood of the Baltoro glacier, Skardu, Askole, and Srinagar. As will be seen by the titles, the subjects vary considerably, some being of native villages and their inhabitants, whilst the greater number are of mountain scenery.

(1) The Indus at Skardu; (2) Corner of fort near Skardu; (3) Shigar valley; (4) Shigar valley at Alchori; (5) Rajah and suite at Shigar; (6) Village of Shigar;

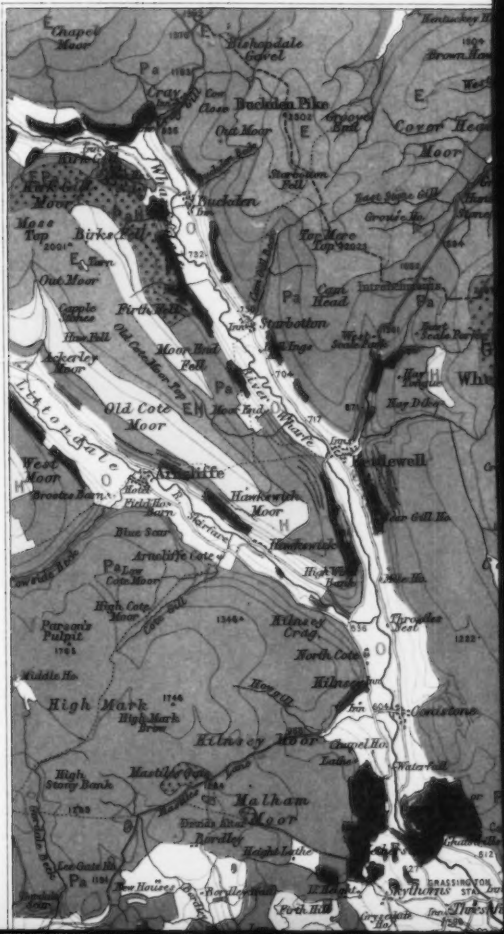
(7) Doctor operating on native at Tolti; (8) Entrance of Bralduh valley; (9) Log bridge, Ghomboro, Bralduh valley; (10) Pakorah rope-bridge, Bralduh valley; (11) Second rope-bridge, Bralduh valley; (12) Hot sulphur spring, near Askole; (13) Rope-bridge at Askole; (14) At Askole; (15) At Askole, Mango Gusor in the distance; (16) Mango Gusor, from Askole; (17) Coolies leaving Askole; (18) Approaching Biafo glacier; (19) Side of Biafo glacier; (20) Camp at Paigu; (21) Fording Punma torrent; (22) Provision house built at Paigu; (23) Crags near Bardumal; (24) View south from Paigu; (25) Near Baltoro snout; (26) Snout of Baltoro glacier; (27) View of surface of Baltoro glacier; (28) Camp 1 on glacier Liligua; (29) Looking across Baltoro glacier from near Liligua; (30) Looking west-north-west from Khobutse; (31) Khobutse Lunguia; (32) View from Khobutse; (33) View from near Khobutse; (34) Trongo Brawsa glacier; (35) View taken from a point between Liligua and Khobutse; (36) Castle peak, north-west of Khobutse; (37) View looking across Baltoro glacier from Khobutse; (38) Second tributary on left bank of Baltoro; (39) View from near Rdokass; (40) Looking east-north-east from Rdokass; (41) Distant view of Gusherbrum from near Rdokass; (42) Rdokass; (43) Avalanche *débris* and nullah near Rdokass; (44) The cave near Lhungka; (45) Looking south-east from Lhungka; (46) Mundu glacier; (47) Masherbrum from between camps 4 and 5; (48) Masherbrum from Lhungka; (49) Masherbrum from near Lhungka; (50) The Mustagh tower; (51) Mustagh tower and Younghusband glacier; (52) Gusherbrum from between camps 6 and 7; (53) Golden Throne from Doksau; (54) Mitre, from camp 7; (55) Mitre from near camp 7; (56) Mitre from junction; (57) Peak next to Mitre on west, from camp 7; (58) Golden Throne from near camp 7; (59) Gusherbrum from junction; (60) Mitre from near camp 8; (61) Mitre from Godwin-Austen glacier; (62) Entrance to first right-hand tributary of the Godwin-Austen glacier; (63) South bank of first right-hand tributary of the Godwin-Austen glacier; (64) North bank of first right-hand tributary of the Godwin-Austen glacier; (65) Mitre from near Sunchon; (66) Chogo-Ri from near camp 8; (67) Broad peak from near camp 8; (68) Chogo-Ri from Godwin-Austen glacier; (69) Looking south down Godwin-Austen glacier; (70) Chogo-Ri from camp 8; (71) Chogo-Ri from between camps 8 and 9; (72) Seracs at junction of Godwin-Austin glacier with its eastern branch; (73) Looking up east branch of Godwin-Austen glacier; (74) Coolies approaching camp 9; (75) Looking south down Godwin-Austen glacier, Bride peak in distance; (76) Snout of glacier hanging on Chogo-Ri close to camp 9; (77, 78, and 80) Camp 10, 18,500 feet; (79) Arrival of coolies at camp 10; (81) Broad peak from camp 10; (82) Looking down east branch of Godwin-Austen from camp 10; (83) An avalanche falling down slopes of Chogo-Ri; (84) The same avalanche as in photograph 83, crossing the glacier; (85) Looking down glacier from camp 10; (86) Looking south-east from camp 10; (87) Looking down glacier from between camps 10 and 11; (88) Camp 11, 20,000 feet; (89) Chogo-Ri from east side; (90) The pass, about 21,000 feet, Chogo-Ri; (91) On ski near camp 11; (92) Staircase peak, near camp 11; (93) East ridge of Chogo-Ri and Staircase peak; (94) Looking south-east from camp 11; (95) Staircase peak from camp 11; (96) Last view of Baltoro glacier; (97) Coolies coming up Skoro glacier; (98) Skoro-ta pass; (99) Peak seen from summit of Skoro-ta; (100) Crags at summit of Skoro-ta; (101 and 102) Raft on Shigar river; (103) The Deosai plains; (104) Ford on the Deosai plains; (105) Looking down valley from Burzil; (106) Burzil bungalow on the Gilgit road; (107) The Jhelum river above Srinagar; (108, 109, 113, and 120) Srinagar; (110) Skardo; (111) A native house-boat on the Jhelum river below Srinagar; (112) Near Askole; (113) The Mohammedan mosque and Hari Parbat, Srinagar; (114) The big mosque, Srinagar; (115) The fourth bridge over the Jhelum at Srinagar; (116) A village near Srinagar; (117) The Chenar Bagh, Srinagar; (118) The Kashmir road; (119) The Jhelum river at Srinagar, Takht-i-Suleiman in background; (120) In Srinagar, near Chenar Bagh; (121) A ruined temple near Srinagar; (122) Bramallah.

Mt. Kilimanjaro. **Johannis.**

Two Photographs of the Kibo Crater, Kilimanjaro taken by Captain Johannis. *Presented by A. F. Wilcken, Esq.*

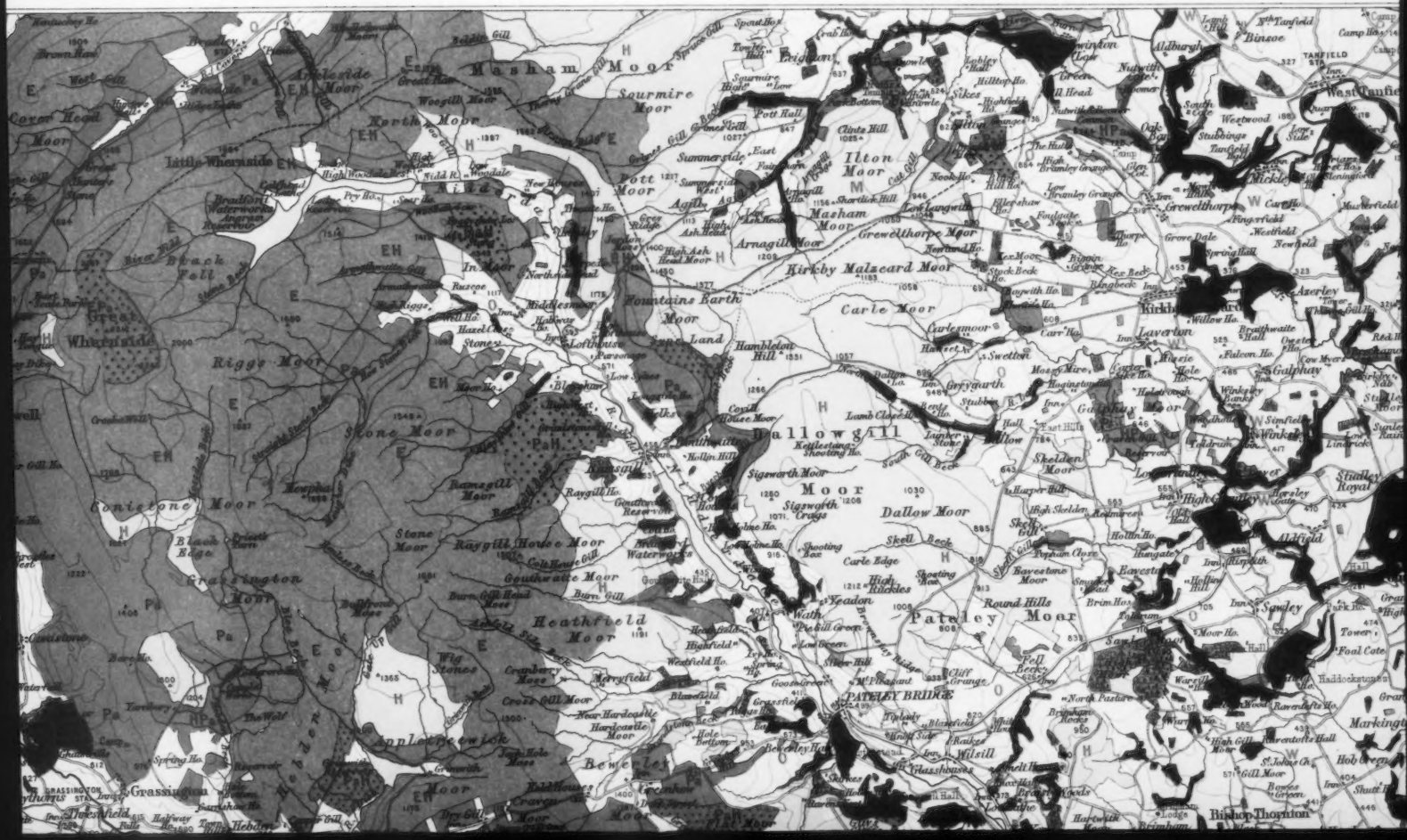
These two photographs were taken by Captain Johannis, the acting governor at Dar-et-Salaam, during a visit to Mount Kilimanjaro last year. They show the interior of the crater of Kibo, one of the left side, and the other of the right.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.


Chapel Moor
Bishopdale Gavel
Buckden Pike
Coven Head
Moor
Birkett Common
Moor
Mase Top
Birkett Hill
Out Moor
Capple Tarbet
Firth Moor
Scarbottom
Intrenchment
Hare Hill
Moor End Fell
Ackarley Moor
Old Cote Moor
Littondale
West Moor
Arncliffe
Hawkswick Moor
Hawkswick
Blue Scar
Arncliffe Cote Moor
Low Cote Moor
High Cote Moor
Parson's Pulpit
Kilnsey Crag
Tarnber Seat
North Cote
Middle Ho.
High Mark
High Mark Brow
Kilnsey
Kilnsey Moor
Conistone
Gravel Ho.
Leather
Waterfall
High Stony Bank
Mastiff Green
Malham Moor
Nordlef
Height Leather
Pa
Rylstone
Fell
Grassington
Moor
Rylstone
Fell
Hare Stones
Rylstone
Moor
Fork Hill
Grassington
Moor
Hare Stones

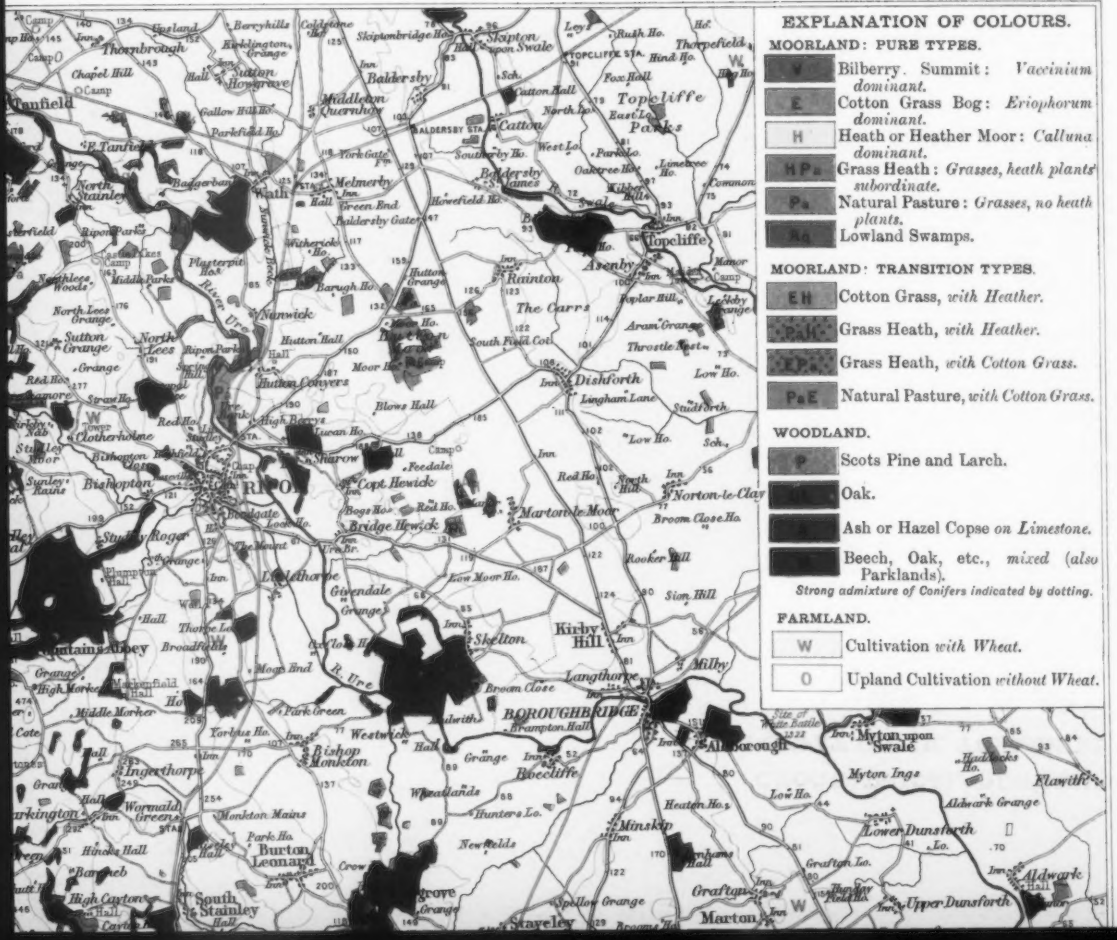
GEOGRAPHICAL DISTRIBUTION OF VEGETATION IN YORKSHI

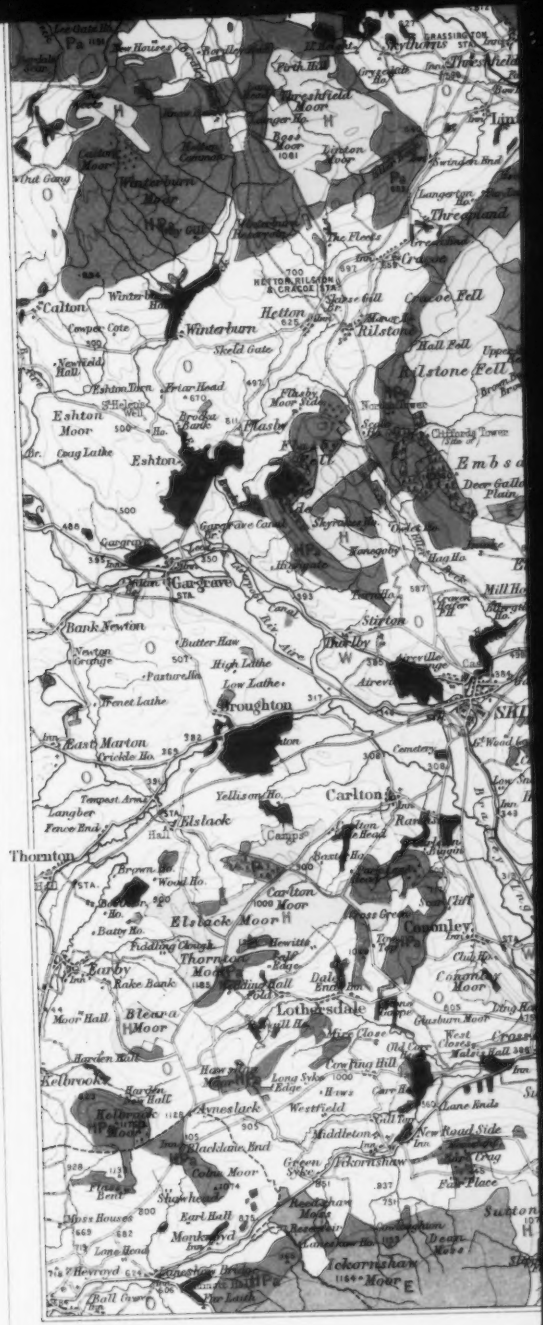
HARROGATE & SKIPTON DISTRICT. BY WM. G. SMITH & W. M. RANKIN.

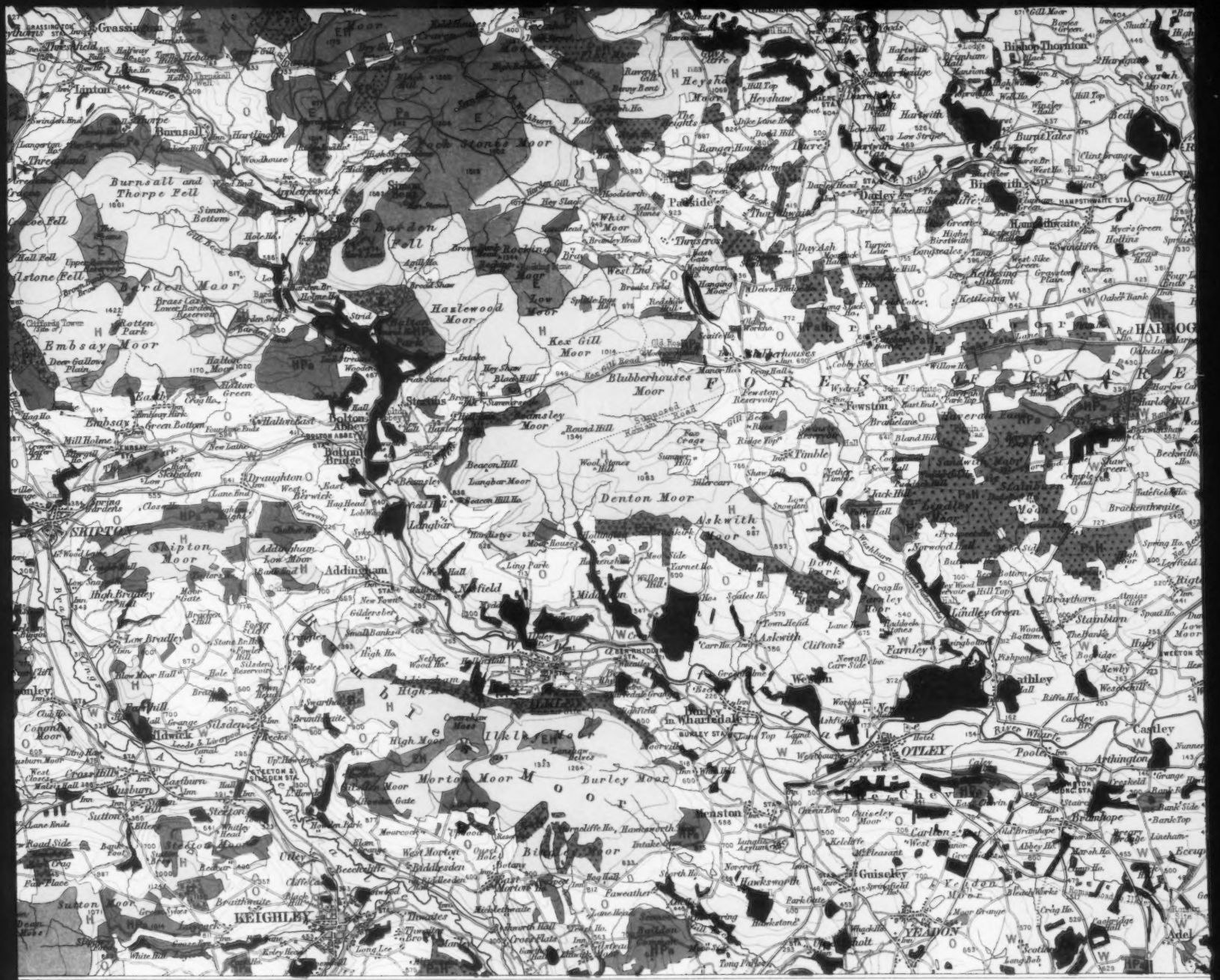


EHIRE - PART II.

N.




Calton
Winterburn
Hetton
Rilstone
Eshton Moor
Eshton
Gargrave
Bank Newton
Stirton
Broughton
East Marton
Carlton
Elslack
Thornton
Elslack Moor
Carleton Moor
Earby
Bleara Moor
Lothersdale
Kelbrook
Ayneslack
Blackdale End
Cokes Moor
Monkroyd
Ickornshaw
Ickornshaw Moor
Cowling Hill
Cowling
New Road Side
Sutton
Winterburn Reservoir
Hetton Pike
Rilstone Fell
Embsay
Skipton
Thorlby
Carleton Moor
Lothersdale Moor
Kelbrook Moor
Ickornshaw Moor
Cowling Hill
Cowling
Sutton
Skipton

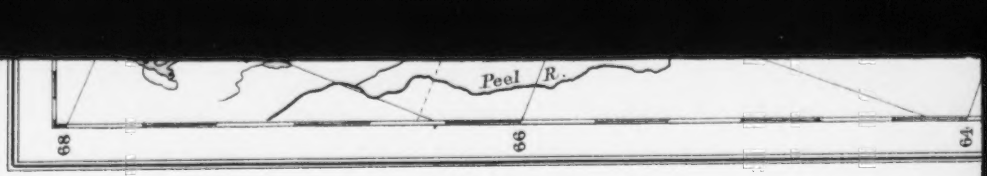


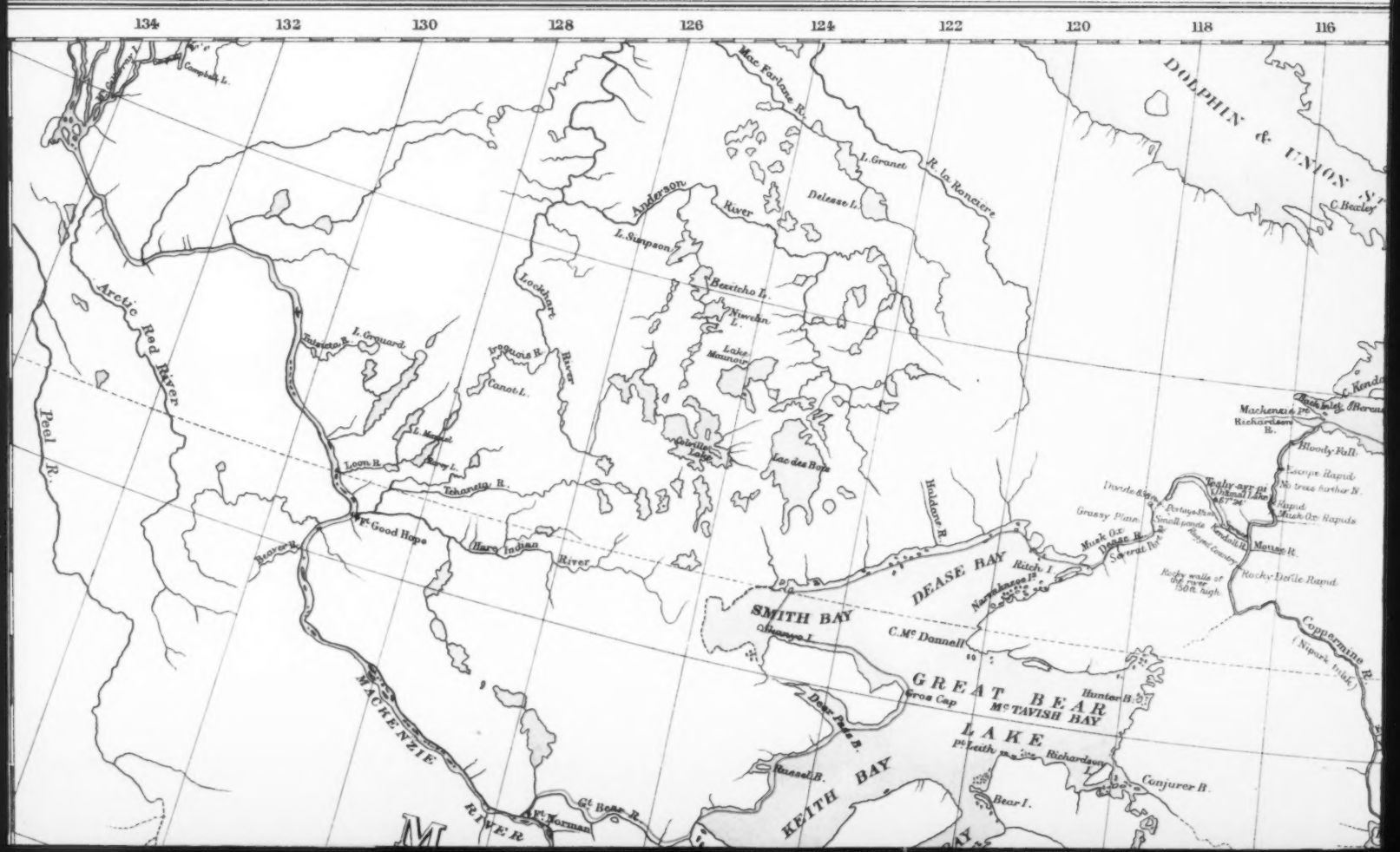
SCALE 1 : 126,720 = 2 MILES TO AN INCH

0 1 2 3 4 5 6

Published by the Royal Geographical Society.

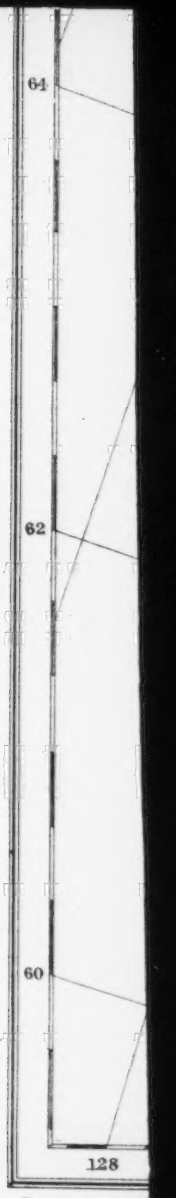
KNARESBOROUGH
HARROGATE
WETHERBY
Goldsbro'
Starbeck
Harrogate
Farnham
Scotton
Scriven
Bilton
Follifoot
Spofforth
Kirk Deighton
Kirkby Overblow
Linton
Collingham
Thorp Arch
Boston Spa
Harewood
Weardley
Bardsey
Rigton
Thorner
Shadwell
Wike
Ecup
Adel
Weeton
Dunkeswick
Walton
Wighill
Bramham
Clifford
Newton Kyme
Toulston
Tockwith
Marston Moor
Battle of Marston Moor A.D. 1644
Cowthorpe
Hunsingore
Cattal
Whixley
Great Ouseburn
Little Ouseburn
Marton
Upper Dunsforth
Allerton Mauleverer
Flaxby
Green Hammerton
Kirk Hammerton
Thorpe Green
Staveley
Stainley
Ripley
Clareton
Conythorpe
Claro
Ferrensby
Arkendale
Nidd
Ouse
Wharfe
Cock
Rivers
Lodge
Moor Side
Lingcroft
Deighton Grange
Ingmanthorpe
Beckerton
Bilton Grange
Bilton Haggs
Walton Lo.
The Grange
Wighill Inn
Thorp Arch
R. Wharfe
Newton Kyme
Toulston Hall
Toulston Cottages
Inholmes
Stutton
Stutton Grove
Headley Hill
Bramham Moor
Site of Battle 1408
White Quarry
Castle Hill
Cockett Hill
Moat Ho.
Wise Warren
Well Hill
Tarnhill
Norwood
Kellfield Grange
Lit. Moor
Brandon Ho.
Shadwell Inn
Wike Inn
Bardsey Hill
Bardsey Grange
Rigton Grange
Rigton Hill
Rigton Inn
Compton
West Wood
Eastwood
Harewood Br.
Harewood Bridge
Bondgate
Middlefield
Fairfield Ho.
Keswick Field
Keswick Ride
Keswick Inn
Banks Ho.
Linton Hills
Linton Inn
Stockeld Lo.
Stockeld Grange
Sicklinghall
Addlethorpe
Barrowby Grange
Netherby
Hearsley
Crown End
Low Moor
Dunkeswick Lo.
Weeton Sta.
Moor End
Rigton
Low Hall
Park
Spofforth Moor
Spofforth Haggs
Cold Bed
Sunrise
High Snape
Low Snape
Spofforth Hill
Spofforth Castle
Spofforth Inn
Stockeld Grange
Kirk Deighton Inn
North Deighton
St Helens Well
Crooks
Old Ford
Old Ford Inn
Ingmanthorpe
Fairfield Villas
Boggart Ho.
Hall Park
Parkhill
Flintmill Grange
Walton Inn
Walton Lo.
The Grange
Wighill Inn
Moat Ho.
Thorp Arch
R. Wharfe
Boston Spa
Newton Kyme
Toulston Hall
Toulston Cottages
Inholmes
Stutton
Stutton Grove
Headley Hill
Bramham Moor
Site of Battle 1408
White Quarry
Castle Hill
Cockett Hill


Peel R.
68
66
64

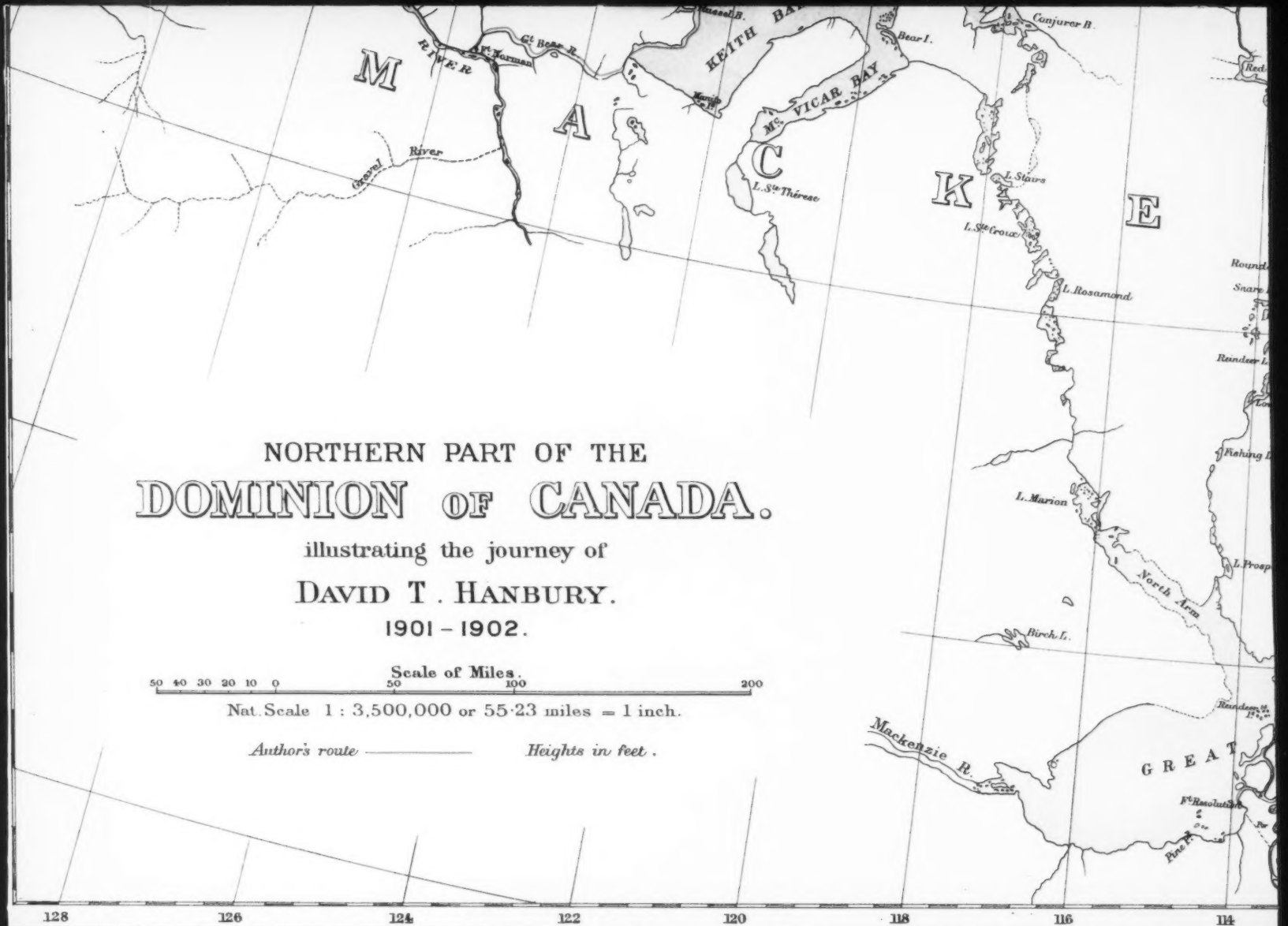

134
132
130
128
126
124
122
120
118
116
DOLPHIN & UNION S.
Mac Farlane R.
L. Granet
R. la Roncaire
Delesse I.
Anderson River
L. Simpson
C. Beaufort
Bernicho L.
Niwehn L.
Lockhart River
Arctic Red River
Peel R.
Trout R.
L. Conguard
Lac Maurice
Canot L.
Lake Maunoir
L. Mallet
Berry L.
Loon R.
Tsharyetq R.
Fort Good Hope
Beaver R.
Hare Indian River
Lac des Bois
Holdsow R.
Mackenzie Pt.
Richardson R.
Bloody Fall
Escape Rapid
No trees further N.
Rapid
Musk Ox Rapids
Grassy Plain
Portage Rapid
Small ponds
Musk Ox
Dease R.
Several Rapids
Rapid
Mouse R.
Rocky walls of the river 150 ft. high
Rocky Defile Rapid
DEASE BAY
Ritch I.
Nowkhasse Is.
SMITH BAY
Thorpe I.
C. Mc Donnell
Coppermine R.
(Nipark trib.)
GREAT BEAR LAKE
Mc TAVISH BAY
Hunter B.
Gros Cap
Deer Pass R.
Pt. Keith
Richardson I.
Conjurer R.
Bear I.
Russell B.
KEITH BAY
MACKENZIE RIVER
Ft. Norman
Gt. Bear R.

116
114
112
110
108
106
104
102
100
98
96
VICTORIA LAND
WOLLASTON LAND
KING WILLIAM LAND
VICTORIA ST.
CORONATION GULF
KILLING-OU-VAK
KENT PENINSULA
Deer in Winter
Low Shore
In Inlet
Melbourne I.
(Kaek-ak-tar-vuak)
Lind I.
ADELAIDE PENINSULA
O'Reilly I.
Barrow Inlet
Pt Duncan
King I.
Gage Pt
Lake Franklin
Chester B.
Ogden B.
Peel-ok-kak
Ragged Country
Occasional rapids
Flat Country
Rocky Country very hilly and no moss or timber
Iniak-tow-wik L.
Deer Cross
Te-her-uak L.
Level Country
Low and undulating
Lake Pelly
L. Garry
L. Macdougall
Backs R.
Rapids
Escape Rapid
Sinclair Fall
Montresor R.
Arctic Circle
BATHURST INLET
Um-ing-mik-tar
(very high land about 1500 ft.)
Kunn-yuk-tuk I.
(native copper reported)
Hood River
Wilberforce falls
Tinney Cove
Young I.
Gordon B.
Hope B.
Surrender to Young Hill
Melville Hills
Hanbury R.
Thelon R.
Burnside R.
Anaktuvuk R.
Dubawnt R.
Kazan R.
Ellice R.
Red Rock L.
Shoal Lakes
Undulating Prairie
300 to 600 yds wide

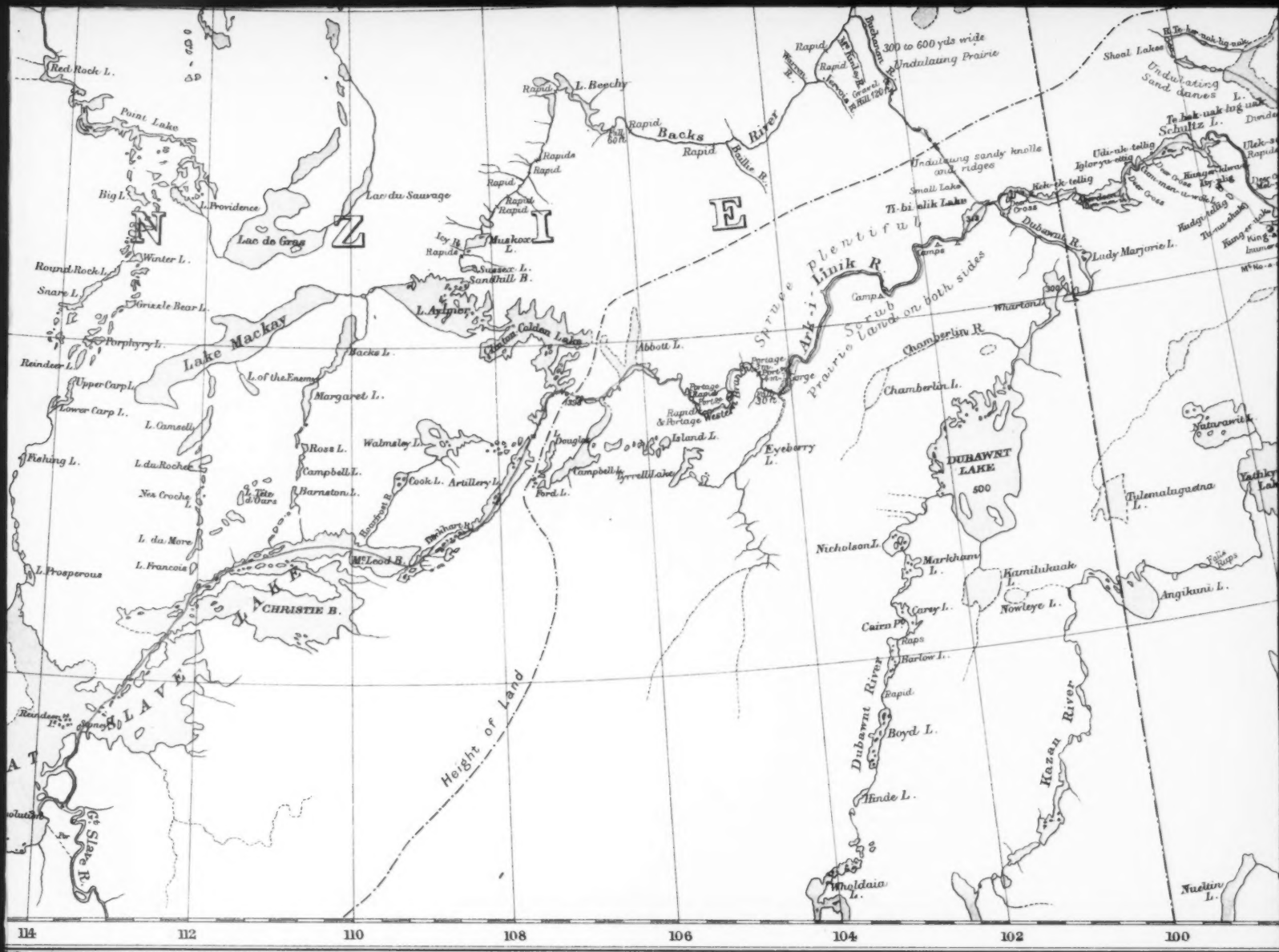
94
92
90
88
86
84
FRANKLIN
ISTHMUS
Pelly B.
COMMITTEE B.
C. Hay
Cantwell I.
C. Beaufort
Pte Backhouse
Hayes R.
Cockburn B.
Rapids
Rapids
Height of Land
Repulse Bay
(I-u-dlik)
66
WAGER R.
Wager R.
(Ne-nak-kak)
64
IV
I
T



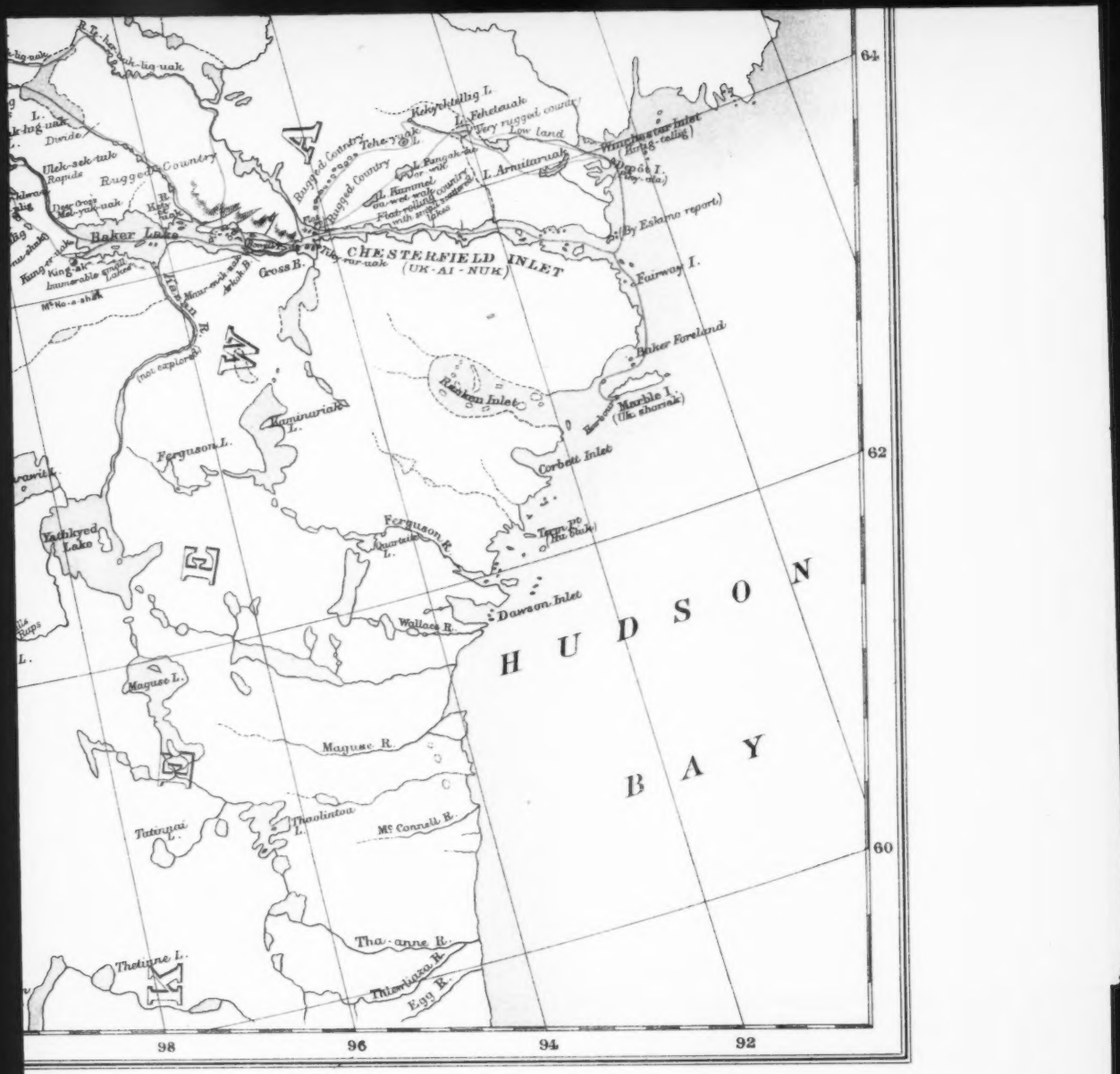
Secant Conical

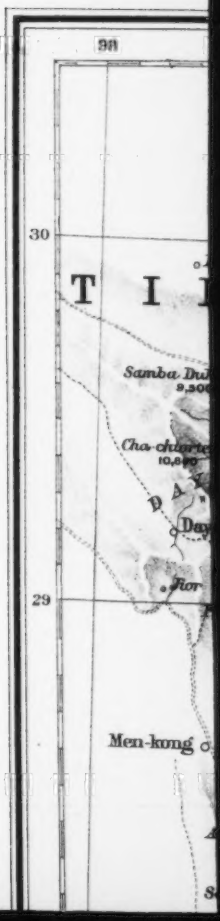


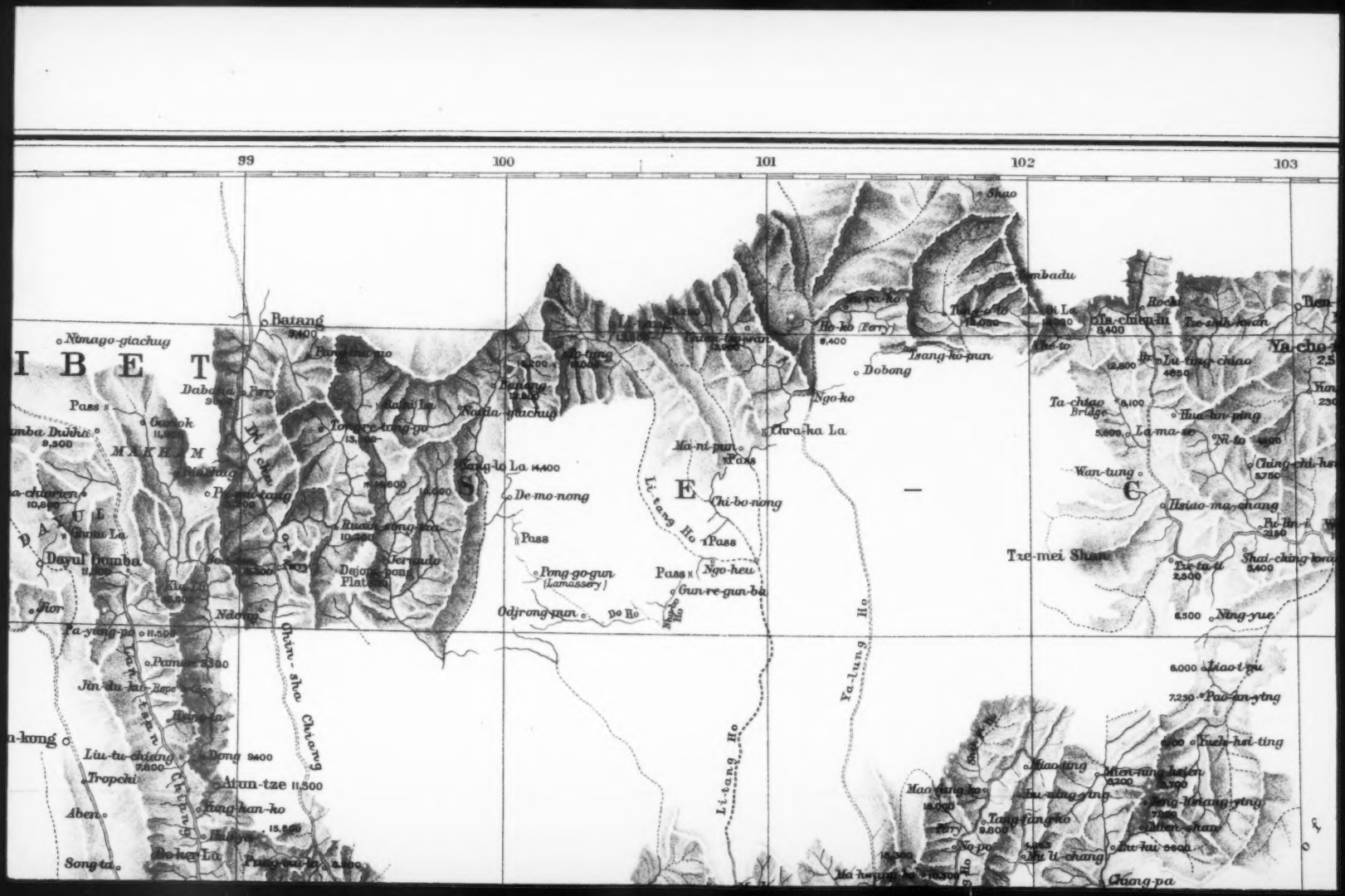
Lambert Conical Projection



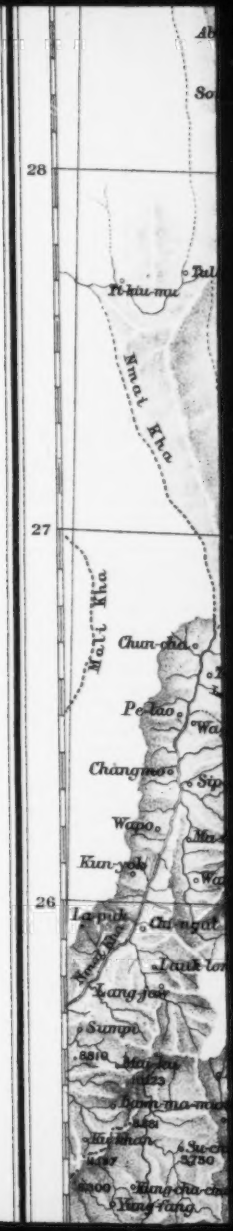
Published by the Royal Geographical Society.

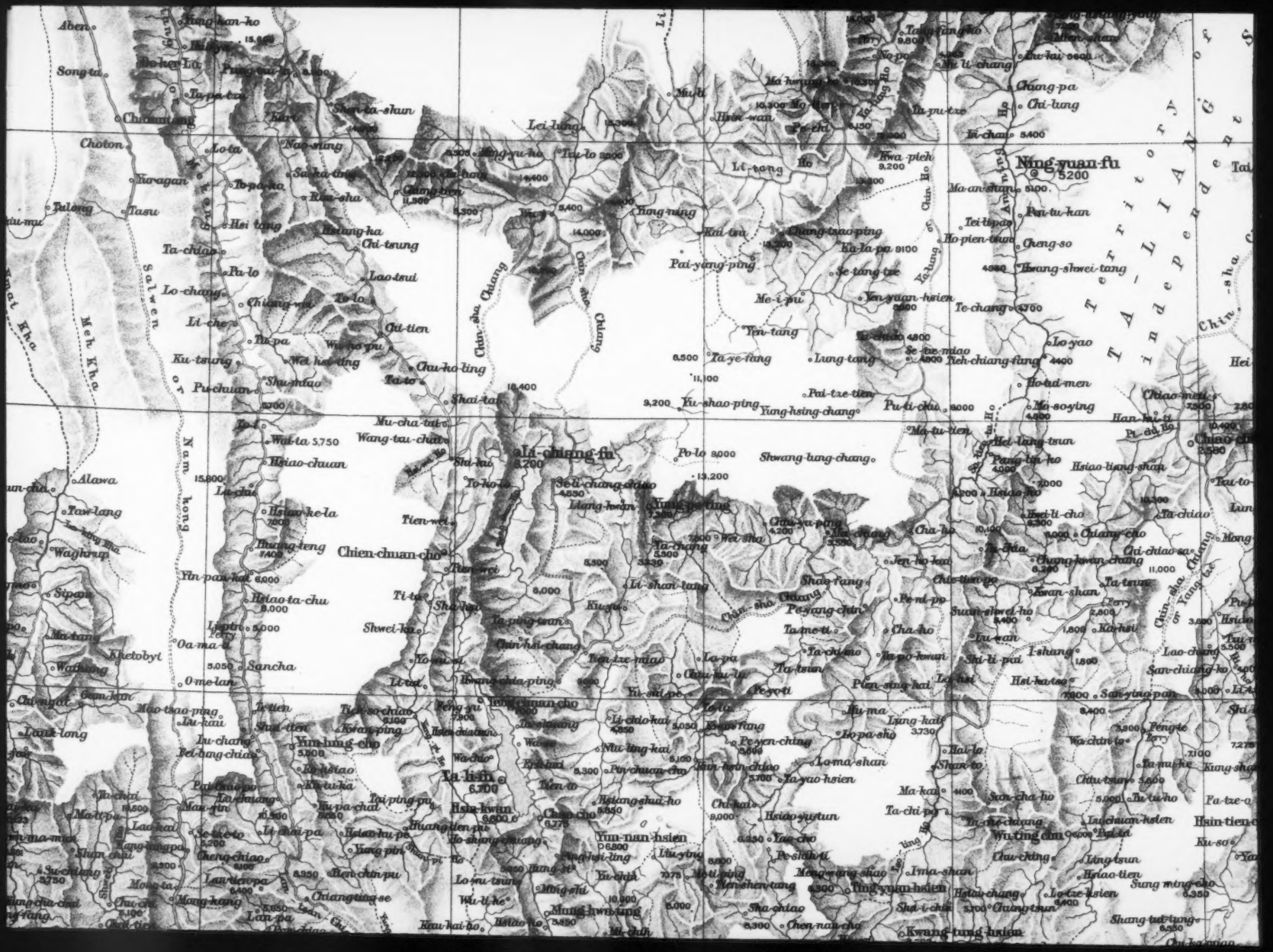

Baker Lake
CHESTERFIELD INLET
(UK-AI-NUK)
Gross B.
Rankin Inlet
Marble I.
Baker Foreland
Fairway I.
Corbett Inlet
Ferguson L.
Ferguson R.
Quartzite L.
Dawson Inlet
Wallace R.
Maguse L.
Maguse R.
Tirinqai L.
Thaolintoa L.
Mc Connell R.
Tha-anne R.
Thelqne L.
Thlewiaza R.
Egg R.
HUDSON BAY
64
62
60
98
96
94
92

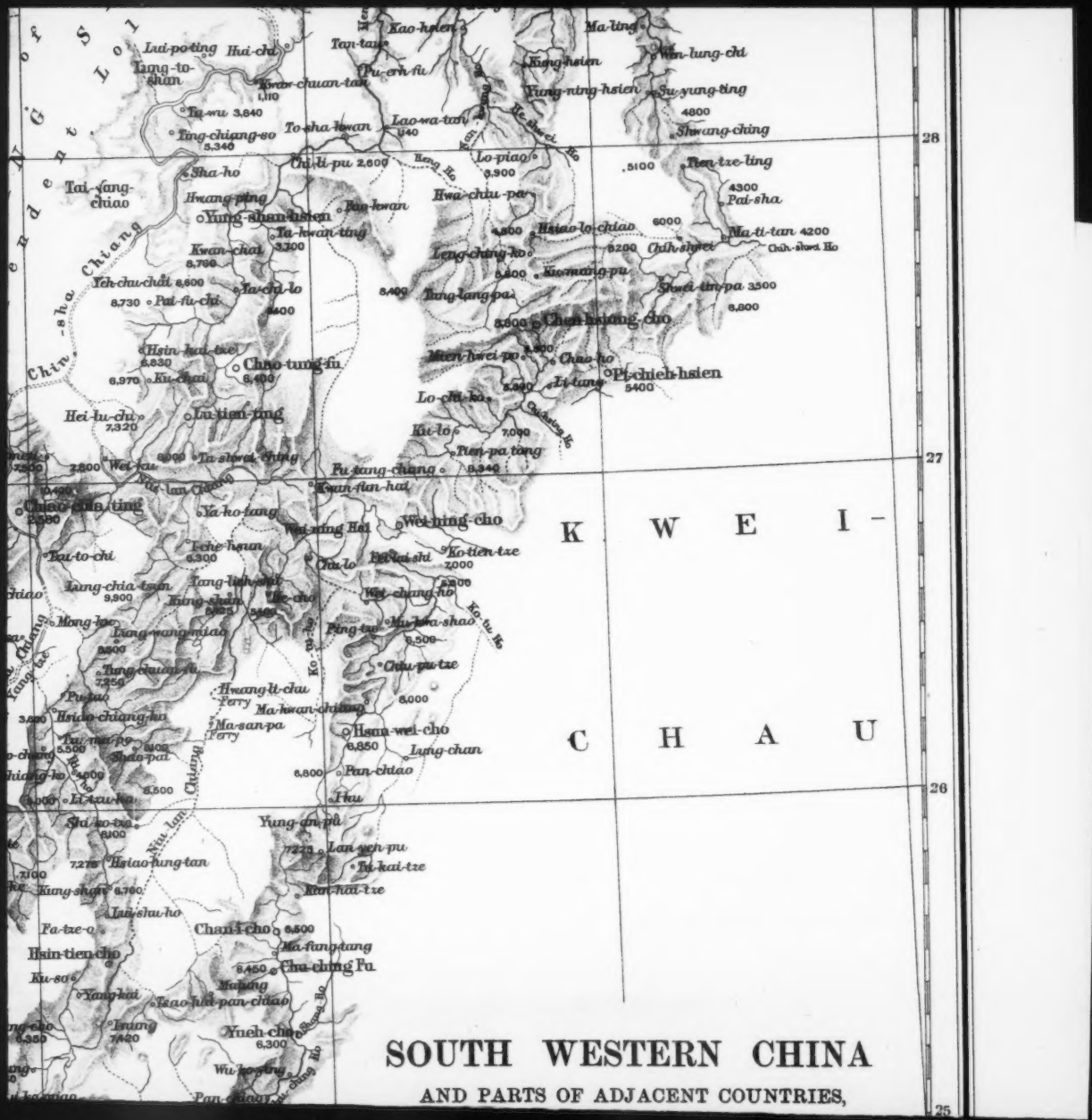

96
30
T I
Samba Du
9,30
Cha-churu
10,8
Day
Jior
29
Men-kung
8


99
100
101
102
103
I B E T
Batang
Nimago-giachug
Pass
Gartok
Dayul Dumba
Pa-yang-pa
Pamo
Jin-du-jai
Liu-tu-chiang
Tropchi
Aben
Song-ta
Ndong
Chin-sha Chiang
Arun-tze
Yung-kan-ho
Ba-ker La
Pung-cai-la
Dejong-pong Plateau
Jerundo
Ruan-tong-tso
Tong-ta-tang-yo
Nanda-yachug
Wang-lo La
De-mo-nong
Pass
Pong-go-gun (Lamassery)
Odjrong-pun
De Ho
Li-tang Ho
Ma-ni-pun
Pass
Chi-bo-nong
Pass
Ngo-heu
Gun-re-gun-ba
Ho-ko (Ferry)
Tsang-ko-pun
Dobong
Ngo-ko
Chwa-ka La
Shao
Tambadu
Ya-lung Ho
Ta-chiao Bridge
La-ma-se
Wan-tung
Tze-mei Shan
Ning-yue
Ya-cho
Tze-ta-li
Shai-ching-tong
Miao-ting
Mien-ning-hsien
Tang-tang-ko
Na-po
Ma-hwang-ho
Chang-pa

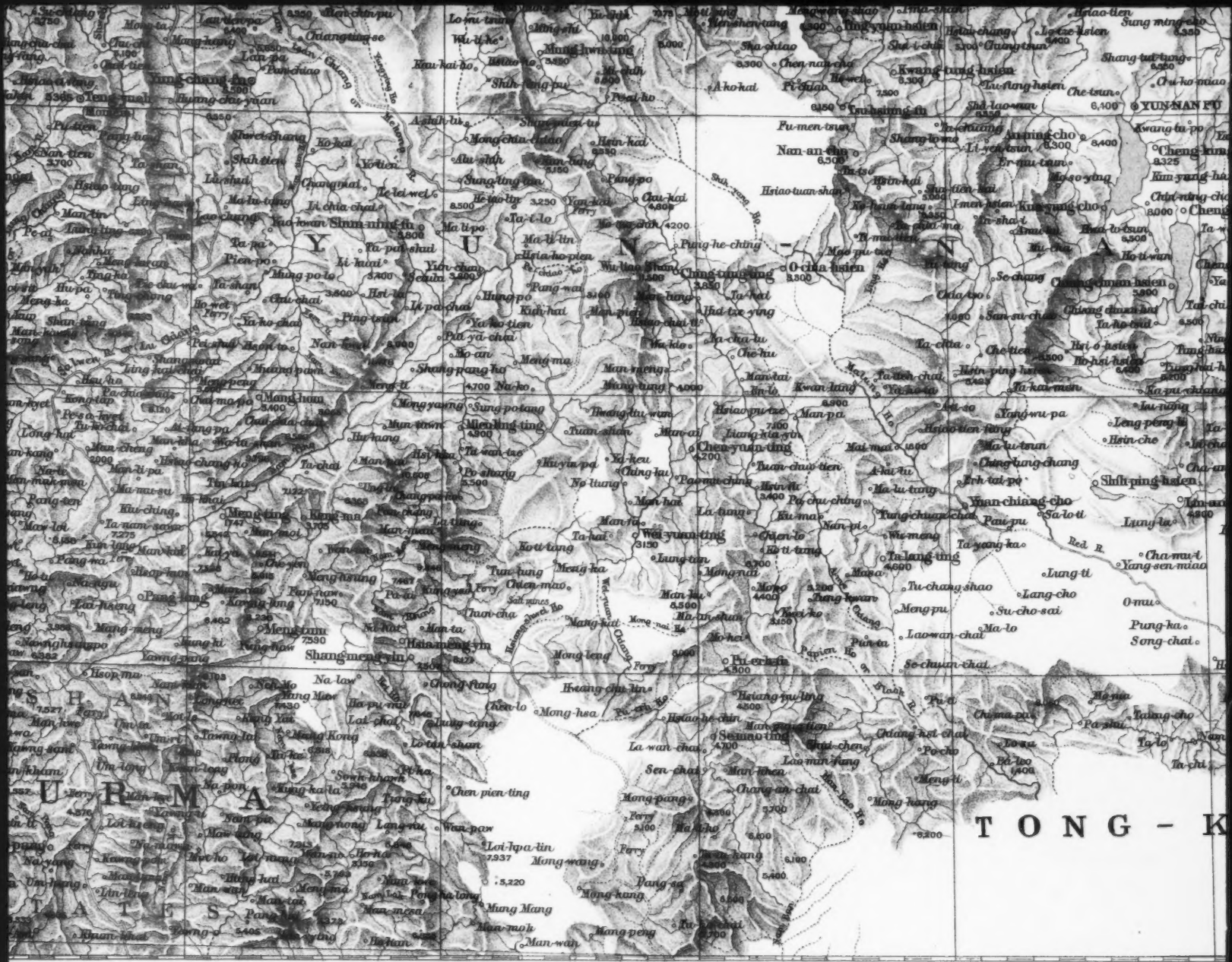
103
104
105
106
30
Chiung Cho
1740
Hsin-ching-hsien
1540
Ta-tung-pu 2100
Ching-lung-chiao
Hsin-tien-tsu 2750
Peng-shan-hsien
1400
Tien-chun-chu 3000
Ming-shan-hsien
Mei-cho 1350
Chang-chia-kan
Ya Ho
Chin-shan-hsien
Yung-ching-hsien
2300
Chia-chiang-hsien
Pan-chiao-chi
O-mei Shan
11,000
O-mei-hsien
1300
China-ting-fu
1,100
Chang-tung
Sha-pan
Yung-hsien
Sha-wan
Fu-lu-chang
Wa Shan
10,550
Liu-lang-pu
Sha-ping
1500
Tung-kai-chang
Chien-wei-hsien
Shwang-lung-chiao
O-pien-ting
Ma-liu-chang
Ma-pien-ting
Cho-pa-chang
Chang-pan-po
Shui-tien-ping
Shih-chang-kang
Huang-sha-chi
Sui-fu 800
Nan-chi-hsien
Chung-fu
Ping-shan-hsien
Pe-shui-chi
Nan-kwang
Fu-kwan
Chiang
An-pien-hsien
970
Chuo-pang-ao
2740
Heng-chang-chang
Ching-fu-hsien
Kao-hsien
Tan-tan
Pu-chi-fu
Kwan-chuan-tan
1,110
Lui-po-ting
Hui-chi
Lung-to-shan
Kiung-hsien
Yung-ning-hsien
Ma-ling
Wan-lung-chi
Su-yung-ting
Tung-liang-hsien
Ta-tze-hsien
Ching Jiu Ho
Wu-chia-pu
Hu-lu-ho
Nei-chiang-hsien
Yuan-shui Ho
Lung-chang-hsien
1350
Yung-chuan-hsien
Chiang-ching-hsien
Chia-lin Ho
Chung-ching
Ta-to-ho
Pao-sha-tu
Shih-men
Kung-shih-pan
Chang-hsin-hsang
Lu-chau
Ho-chiang-hsien
2100
Tai-pin-chang
2600
Ma-ling
Wan-lung-chi
Su-yung-ting
Yung-ning-hsien
Tze-cho
Tze-lui-ching
1130
Fu-shan-hsien
Shih-chang-kang
Chang-an-hsien
Yang-tze
Kiang
Chin
Sha
Tang
Lolos of the SHAN

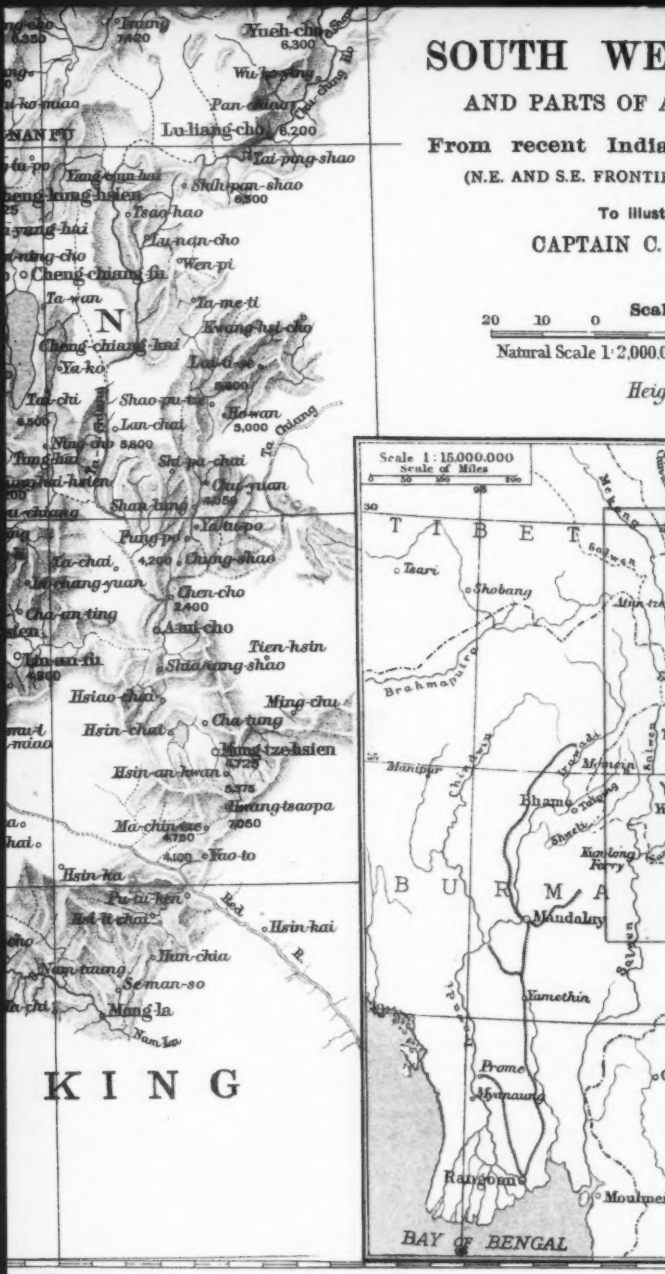

28
27
26
Mali Kha
Chun-chia
Pe-lao
Changmao
Wapo
Kun-yeh
La-puk
Sumpo
Yang-fang


Ning-yuan-fu
5200
Ta-li-fu
6,700
Ta-li-hsien
6,700
Yung-pei-ting
Chien-chuan-cho
Ti-tsu
Shwei-ka
Yin-pan-kai
Hsiao-ta-chu
Sancha
Khetobyl
Waghung
Waghrap
Sipaw
Alawa
Lu-chiang
Nam Kong
Salwen
Meh Kha
Nmai Kha
Chin-sha Chiang
Yang-tze Kiang
Li
Mekong
Choton
Chamutang
Song-ta
Abeni
Tulong
Tasu
Ta-chiao
Lo-chang
Li-che
Ku-tsung
Pu-chuan
Wai-ta
Hsiao-chuan
Hsiao-ke-la
Hsiang-teng
Ma-tang
Oa-ma-la
O-me-lan
Ta-tien
Yun-lung-cho
Ta-hsiao
Ka-tu-ka
Hsia-kwan
Yun-nan-hsien
Ming-hwa-tung
Ta-chi-pi
Ma-kai
Ma-chan
Ma-shan
Ting-yuan-hsien
Kwang-tung-hsien
Ning-yuan-fu
Ta-chien-lu
Territory of Independent Tibet


Lui-po-ting
Hui-chu
Tang-to-shan
Kwan-chuan-tan
1,110
Ta-wu 3,840
Tang-chiang-so
5,340
To-sha-kwan
Xao-hsien
Tan-tan
Chu-erh-fu
Lao-wa-tan
1,140
Ma-ling
Kung-hsien
Wan-lung-chi
Yung-ning-hsien
Su-yung-ting
4800
Shwang-ching
Chi-li-pu 2,600
Sha-ho
Tai-yang-chiao
Hwang-ping
Yung-shan-hsien
Pao-kwan
Ta-kwan-ting
Kwan-chai 3,700
6,700
Yeh-chu-chai 8,600
8,730
Pai-fu-chi
Ta-chi-lo
8,400
8,409
Lo-piao
3,900
5100
Tien-tze-ling
4300
Pai-sha
Hwa-chiu-pa
4,800
Hsiao-lo-chiao
6000
Ma-ti-tan 4200
Chih-shwei
Chih-shwei Ho
6,200
Leng-chung-ko
5,400
Kio-mang-pu
Shwei-tin-pa 3500
6,800
Tung-lang-pa
5,500
Chen-hsiang-chu
Hsin-hai-tze
6,830
Chao-tung-fu
6,970
Ku-chai
6,400
Mien-hwei-po
3,800
Chao-ho
2,540
Li-tung
Pi-chieh-hsien
5400
Lo-chi-ko
Hei-lu-chu
7,320
Lu-tien-tung
Ku-lo
7,090
Tien-pa-tong
Chihshwei Ho
Wei-tze
6,000
Ta-shwei-ching
Pu-tang-chang
8,340
Kwan-fan-hai
Chiao-chia-ting
2,580
Ya-ho-tang
Wei-ning Hai
Wei-ning-cho
K W E I -
Tau-to-chi
I-che-hsun
6,300
Chu-lo
Pai-lei-shi
Ko-tien-tze
7,000
Liang-chia-tsun
9,900
Yang-lieh-shi
Hsing-shan
5,825
Tze-chu
5,400
Wei-chang-ho
6,500
Mong-loo
Liang-wang-miao
8,500
Ping-tze
Mu-kwa-shao
8,500
Ko-tu Ho
Chiu-pa-tze
Tung-chuan-fu
7,250
Hwang-li-chu
Ferry
Pu-tao
Ma-kwan-chiang
6,000
Hsiao-chiang-kou
3,220
Ma-san-pa
Ferry
Hsia-wei-cho
6,850
C H A U
Lung-chan
5,500
Shao-pai
6,800
Pan-chiao
Hsu
Li-tzu-ko
6,500
Sui-ko-tze
6,100
Yung-an-pu
7,270
Lan-yeh-pu
Hsiao-lung-tan
7,270
Tu-kai-tze
Kuang-shan
6,700
Kan-hai-tze
Liu-shu-ho
Fa-tze-o
Chan-i-cho
6,500
Hsin-tien-cho
Ma-fang-tang
Ku-so
Chu-ching Fu
8,450
Yang-hai
Mabang
Tsao-hui-pan-chiao
Inung
7,420
Yueh-chu
6,300
Wu-ho-ting
Shwei Ho
Pan-chiao
Nan Lan Chiang
Yang-tze Kiang
Chin-sha Chiang
Independent Lolo
SOUTH WESTERN CHINA
AND PARTS OF ADJACENT COUNTRIES,
28
27
26
25

BHAMO
25
24
23
22
Secant conic projection.


YUNNAN
TONG-K
SHAN
BURMA
TATES
Yung-chang-fu
Teng-yueh
Tali-fu
Shun-ning-fu
Nan-an-fu
Ching-tung-ting
O-cha-hsien
Chen-yuan-ting
Wei-yuan-ting
Shang-meng-yin
Meng-tsun
Meng-ting
Mang-hsun-ting
Mang-hsiang
Mang-hsiang-ting
Mang-ham
Mang-yang
Mang-ting
Mang-mao
Mang-mo
Mang-mang
Mang-wang
Mang-kung
Mang-peng
Mang-wan
Mang-mao
Mang-ma
Mang-hai
Mang-ka
Mang-ka-ting
Mang-ka-ting
Mang-ka-ting


SOUTH WE
AND PARTS OF
From recent India
(N.E. AND S.E. FRONTI
To illust
CAPTAIN C.
Scal
20 10 0
Natural Scale 1:2,000,0
Heig
Scale 1:15,000,000
Scale of Miles
T I B E T
Tsari
Shobang
Brahmaputra
Manipur
Bhamo
Mandalay
B U R M A
Yamethin
Prome
Henzada
Rangoon
Moulmein
BAY OF BENGAL
Yuch-chiang
Pan-chiang
Lu-liang-cho 6,200
Tai-ping-shao
Shih-pan-shao 6,500
Tsao-hao
Lu-nan-cho
Wen-pi
Cheng-chiang fu
Ta-wan
Ta-me-ti
Kwang-hui-cho
Cheng-chiang-hsien
Ya-ko
Lan-chai
Shao-pu-tsi
Ta-wan 3,000
Ying-cho 5,800
Shi-pa-chai
Chu-yuan
Shan-tung
Ya-tai-po
Pung-pu
Ta-chai 4,200
Chung-shao
Ta-chang-yuan
Chen-cho 2,400
Cha-an-ting
A-mi-cho
Tien-hsin
Lin-an-fu 4,800
Shan-tung-shao
Hsiao-chai
Ming-chai
Hsin-chai
Cha-tung
Ming-tze-hsien 5,725
Hsin-an-kwan 5,375
Kwang-tsao-pa 7,050
Ma-chin-eze 4,750
4,100 Yao-to
Hsin-ka
Pu-tu-hsi
Red R.
Hsin-kai
Hun-chia
Se-man-so
Mang-la
Nam-Lao
KING

103 104

VESTERN CHINA

OF ADJACENT COUNTRIES,

ndian Government Surveys

ONTIER SHEETS—4 MILES TO 1 INCH),

illustrate the paper by

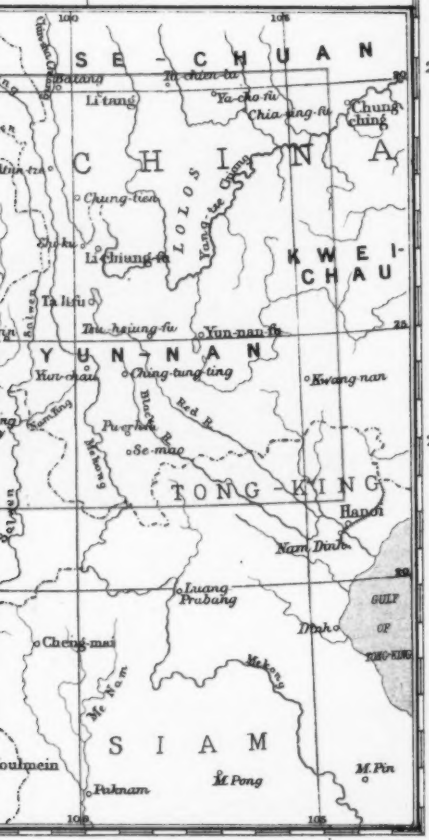
N C. H. D. RYDER, R.E.

Scale of Miles.

20 40 60

2,000,000 or 31·56 Statute Miles = 1 inch

Heights in feet.



105

George Philip & Son Ltd., The London Geographical Institute.